

Azzurra Scarci | Holger Baitinger (eds)

Fragmentation in Greek Sanctuaries and Bronze Age Hoards

An Interdisciplinary Approach



LEIBNIZ-ZENTRUM
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Preface

Few topics in archaeological research are as intensively and controversially debated as fragmented copper-alloy objects and the contexts of their deposition, often in the form of so-called hoards. As early as the transition from the Early to the Middle Bronze Age, »scrap metal hoards« containing such fragmented objects began to appear in Central Europe (Bühl-Ackenbach hoard horizon). These hoards became particularly prevalent during the Late Bronze Age, significantly shaping the archaeological record across vast regions of Europe before seemingly disappearing in many areas at the transition to the Early Iron Age. The suggested motivations behind the deposition of such hoards, which also included intact objects and raw metal (such as copper ingots or »casting cakes«), range from religious offerings to merchants' and founders' hoards intended for recycling or remelting. Given the large number of such hoards in the Late Bronze Age, scholarly debate has often focused on this specific chronological framework. However, similar phenomena and practices can be observed in other regions and periods. Fragmented Cycladic figurines and Viking Age treasure finds containing hack silver and coins are just two of many further examples.

Excavations in major Greek sanctuaries such as Olympia, Delphi, and Samos have also yielded large numbers of copper-alloy objects, many of which have only survived in a fragmented state and bear traces of deliberate destruction. Although these materials primarily date to the Geometric and Archaic periods – a time when the »scrap metal phenomenon« was still widespread across much of Europe – they have rarely been compared with the Bronze Age hoards of Old Europe. This may be due to the relative scarcity of such hoards in Greece during the Late Bronze Age. However, Greek sanctuaries raise a fundamentally similar question: why did such large quantities of copper-alloy objects end up buried rather than being reused or remelted? This question provided the starting point for the research project »Fragmentation of Votive Offerings in the Sanctuary of Olympia – Research on the Background of a Ritual Practice«, conducted at the Leibniz-Zentrum für Archäologie (LEIZA) in Mainz in close collaboration with the Athens Department of the German Archaeological Institute (DAI). Funded by the German Research Foundation (DFG) and running from January 2022 to February 2025¹, this project systematically analysed fragmentation traces on selected material groups, primarily from the Geometric period at Olympia. The research was carried out under the scientific direction of Holger Baitinger through a close collaboration between an archaeologist specialising in metal objects (Azzurra Scarci) and an experienced conservator (Gerhard Stawinoga).

Olympia offers excellent conditions for such investigations, because the large number of objects allows for the identification of recurring fragmentation patterns, while the extensive excavation documentation enables an examination of the spatial distribution of the fragmentation phenomenon within the sanctuary.

¹ DFG GZ BA 3197/2-1, project number 466820328. We are grateful to the German Research Foundation for funding the project and its extension (2026–2028), which will allow the second phase to start in January 2026 with a focus on fragmentation in Olympia and other Greek sanctuaries. Our sincere thanks also go to the German Olympia Excavation, and in particular its director, Oliver

Pilz, for his unwavering support. Additionally, we extend our appreciation to Nevio Dubbini and Annalisa Maggini (Miningful srls, Pisa) for their contributions to the statistical analyses, as well as to Anja Cramer and Benjamin Streubel (LEIZA) for their valuable advice during the spatial analyses.

To integrate the research results from Olympia into the broader discourse on the fragmentation of copper-alloy finds in European hoards and to provide further insights for future studies, we organised the international conference »An Interdisciplinary Approach to the Practice of Fragmentation in Greek Sanctuaries and Bronze Age Hoards«, which took place from 22 to 24 November 2023 at LEIZA (formerly the Römisch-Germanisches Zentralmuseum) in Mainz. The conference featured 14 presentations exploring the topic from various perspectives and methodological approaches. The keynote lecture, delivered by John Chapman and Bisserka Gaydarska, addressed fundamental aspects of fragmentation as both a material process and a means of connecting people and places. This was followed by a thematic session on the sanctuary of Olympia, in which key aspects of votive offerings in Greek sanctuaries were discussed (contributions by Oliver Pilz, Holger Baitinger, and Azzurra Scarci/Gerhard Stawinoga). In recent years, questions concerning »Fragmentation and Use-Wear Analysis« have gained increasing significance. Contributions on this topic were provided by Matthew G. Knight, János Gábor Tarbay, Botond Rezi, Jan-Martin Skolaut, and Christoph Huth. The subsequent session, »Fragmentation and Metrology«, examined the role of standardised weight systems and the »pre-monetary« functions of Late Bronze and Early Iron Age hoards (with contributions by Giancarlo Lago and Nicola Ialongo). Case studies from eastern France (contribution by Estelle Gauthier and Jean-François Piningre) and Iron Age Northern Europe (contribution by Andreas Rau) were then presented in a session devoted to »Fragmentation and Rituals«, which was closely linked to the Olympia session. Rau's presentation focused on fragmented weapons and armour from sacrificial sites dating to the late Roman and Migration periods. The conference concluded with a contribution by Roland Schwab on archaeometallurgical and material analyses, which also outlined perspectives for future research. Unfortunately, Rau's and Schwab's contributions could not be included in the present volume.

This volume of the conference proceedings thus provides a methodologically diverse and geographically wide-ranging overview of current research on the phenomenon of fragmentation, spanning areas from Great Britain to Southeastern Europe, while also reflecting regional research traditions. The fact that this volume could be published within a relatively short time after the conference is primarily due to the contributing authors, who submitted their manuscripts on time, as well as to the editorial team at LEIZA publishing house, especially Claudia Nickel and Marie Reiter, who carried out the editorial work with great dedication and precision.

We extend our gratitude to the DFG for their financial support, which facilitated the timely publication of this book. Special thanks are due to John Chapman, who generously agreed to read and linguistically revise a substantial portion of the manuscript. We are also grateful to Alexander Sarantis (LEIZA) for his careful linguistic revision of the preface.

We hope that this volume contributes to a more comprehensive understanding of the diversity of fragmentation phenomena in the archaeological record and helps to move beyond the often reductive interpretative framework of »sacred« versus »profane«.

Azzurra Scarci and Holger Baitinger
Mainz, March 2025

»The Mirror Spied Upon Us« (Borges)

The Agency of Fragments and Whole Objects in Archaeology and How to Study Them in the Landscape

ABSTRACT

In his story »Tlön, Uqbar, Orbis Tertius«, Borges accuses mirrors of spying upon us – of being »abominable because they multiply and disseminate that universe«. We link Borges' text to the mirror's shared characteristic of having agency with all other material objects and to the multiplication and dissemination of the universe inherent in the act of fragmentation. The starting point in this chapter is the revised »Fragmentation Premise«, which now includes the fragmentation of the landscape to link people and places through the provision of »resources«. In order to integrate the extended Fragmentation Premise with depositional theory and the significance of landscape deposition, we examine three case studies of fragmentation at the landscape scale – the formation of bronze hoards in the Jura Mountains, the deposition of marble figurine and vessel fragments at the Early Cycladic Kavos sanctuary and the deposition of copper objects in the hoards of the Balkan Copper Age.

KEYWORDS

Kavos sanctuary | Jura microregion | Balkan Copper Age | mirrors | fragmentation | object agency | relational archaeology | multiple persons, objects and places

Introduction: a Borges Fable

Jorge Luis Borges' (1940) (**fig. 1**) speculative fictional short story »Tlön, Uqbar, Orbis Tertius« focuses on the author's discovery of the mysterious and possibly fictional country of Uqbar, its legend of Tlön and the secret organization of *Orbis Tertius* that created both locations. A character in the story, Bioy, states that »mirrors and copulation are abominable because they increase the number of men«. Indeed, Borges accuses mirrors of spying upon us and of being »abominable because they multiply and disseminate that universe«. Of the many potential comments on Borges' text, we highlight two: mirrors share the characteristic of having agency with all other material objects; and fragments of objects multiply and disseminate the universe through the very act of fragmentation. In short, we are dealing

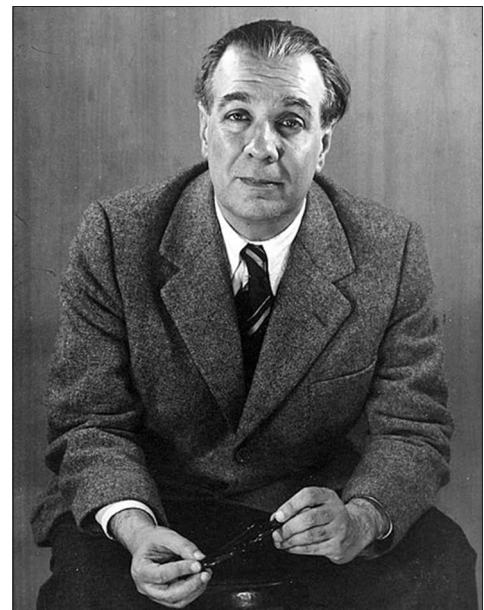


Fig. 1 Jorge Luis Borges in 1951. – (Photo G. Stern).

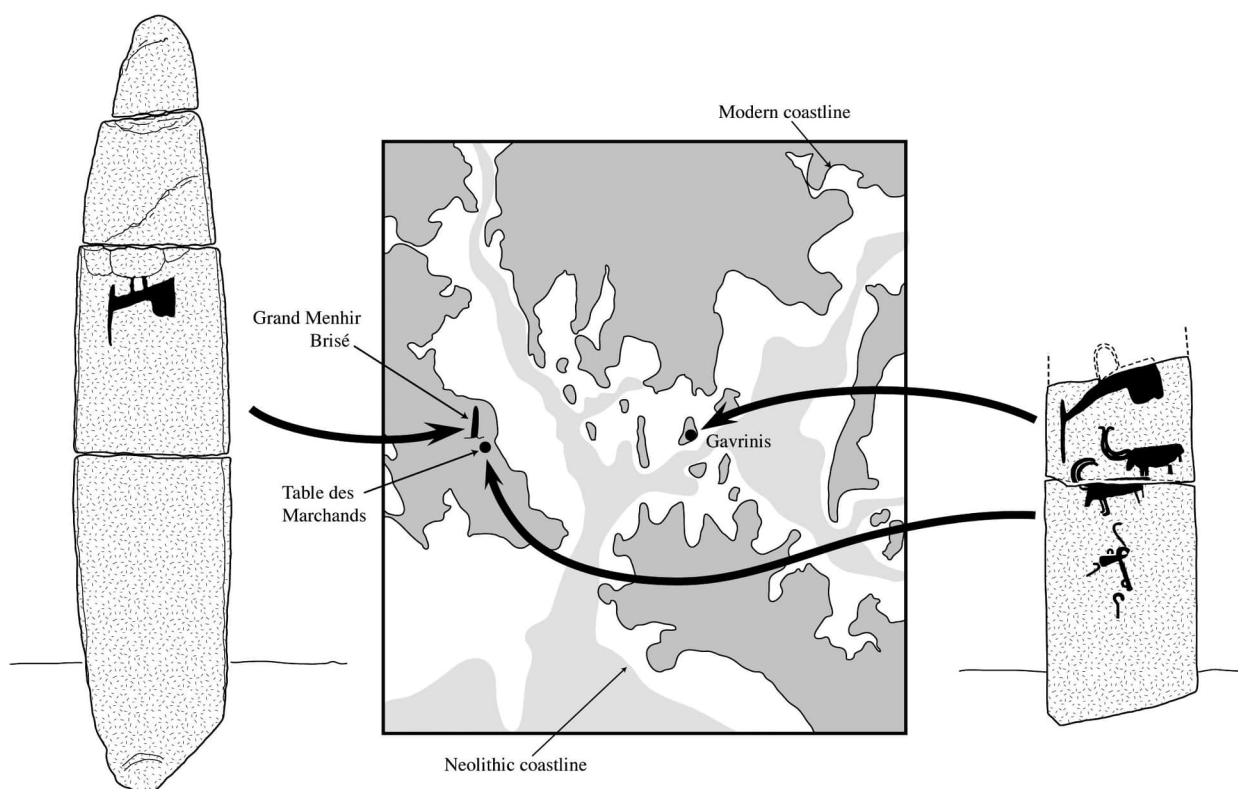


Fig. 2 Re-fitting of Breton megaliths. – (After Scarre 2011, fig. 4.13, based upon information in Le Roux 1984 and Bonniol/Cassen 2009).

with issues of reflection, replication, and reproduction.

The mirror is a common trope in archaeology. Like many processualists, Kate Harrell (2014) talks of swords as »a mirror for Early Mycenaean social ideology«, while Arne Windler et al. (2013) consider the mortuary record as a mirror of coeval social structure. But none of the authors considers whether the reflections provide an accurate or distorted image, nor who is holding the mirror (? themselves, ? someone in the past). This trope is based upon an anonymous subject using object agency; the interpretation of grave goods or swords replicates the objects themselves. In Borges' terms, the universe is multiplied and disseminated, while the fragmentation of a mirror creates new and often distorted patterns.

In fragmentation studies, we have hardly begun to scratch the surface of the relationship between fragmentation, wholes, parts and object agency. If you, the reader, is in any way sceptical of object agency, we invite you to consider two examples of such agency at the opposite ends of the size spectrum. At the minimal end of the spectrum, the use of grog temper in making pots points to a deliberate

choice to crush parts of an existing vessel (or vessels) and add the fragments into the clay recipe (e. g. Harrison et al. 1994). Other common materials were always available, yet the choice of a vessel or vessels was made to incorporate the past into the present and future by citing earlier potters, past users of the complete vessel and those who broke it into sherds. The grog temper has the agency of presencing – bringing into the present – the near or distant (? ancestral) past in a current object.

The second example concerns the massive scale of large carved stone panels in the megalithic tombs of Neolithic Brittany, which have been broken into two or three parts and each part, weighing over 1 metric ton, transported with great difficulty to a different tomb (Le Roux 1984) (**fig. 2**). Here, the agency of the carved blocks is much more obvious, with the presencing of other places and persons in the tomb into which the stone fragment was built, as well as the transfer of the message encoded into the distinctive carved motifs which led to the recognition of the re-fits.

Borges' comment on the multiplication and dissemination of the world through mirrors plainly

applies to many other materials. The disseminated messages accompanying this multiplication reinforced the material agency through the process of enchainment – the linkage of people, places and objects to form relationships (**fig. 3**). As Andrew Meirion Jones has commented (2012, 19), enchainment was one of the most basic, ubiquitous ways of creating relationships in the past. In other words, fragmentation practices were inherently relational.

In this chapter, we have three aims: an introduction of fragmentation research which provides the context for the modification of the initial »Fragmentation Premise« into a more integrated second premise; a consideration of fragmentation studies at the landscape level, using specific case studies; and a re-examination of the landscape as a (dis)continuous

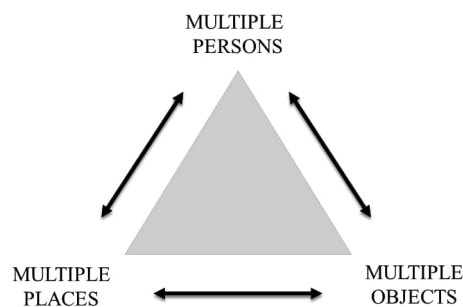


Fig. 3 The identity triangle. – (Graphics A. A. Noterman).

site for depositional practices, whose transformation was closely linked to the agency of the objects therein deposited.

A Selective History of Fragmentation Studies

The personal story of one of the author's accidental discovery of deliberate fragmentation and his attempt to set this in a social context has been told in his memoir (Chapman 2021, ch. 9). Two early inspirations for this research came from Marilyn Strathern and Laurie Talalay. Strathern's theory of enchainment was elaborated in her 1988 book on »The Gender of the Gift« (Strathern 1988). The idea that objects could be used to enchain people and create relations through material culture was central to my fragmentation research, even though enchainment of Balkan objects often relied on their incompleteness. It became gradually clear that, although many Balkan prehistorians – going back to the 1920s – had observed empirical cases of object fragmentation which they sometimes held was deliberate, there were far fewer scholars who sought to provide a social explanation of fragmentation. The most inspiring was Laurie Talalay in her work on the Neolithic figurines deposited in the Franchthi cave (Argolis/GR) (Talalay 1993). The first fragmentation book (Chapman 2000) was an attempt to place that practice into a social framework for relating people to objects. The book considered the history of Balkan research into fragmentation and assessed the signif-

icance of the practice through a general analysis of a number of object categories – figurines, salt-pots, prosopomorphic lids – as well as the human body, in a variety of contexts – domestic, mortuary and landscape hoards.

However, the scope of the first book precluded any in-depth, site-based case study and it was with this aim in mind that the authors started research for a second fragmentation book. The second book (Chapman/Gaydarska 2007) contained studies of what could be done with complete objects, a consideration of Michael Schiffer's taphonomic research on a Balkan context, a review of object re-fitting with studies of both inter-site and intra-site re-fitting and detailed studies of the Hamangia (prov. Dobru-gia/RO) and Dolnoslav (prov. Plovdiv/BG) figurine assemblages as well as the *Spondylus* ornament assemblages from the Varna (prov. Varna/BG) and Durankulak (prov. Dobrich/BG) cemeteries and the Dimini settlement (Thessaly/GR). These five case studies presented the detailed empirical evidence for deliberate object fragmentation but also showed how often the ensuing fragments were used in an extended life, part of which in ways different from the lives of other fragments from the same original object.

An important conclusion in the second fragmentation book was the enunciation of the first formulation of the Fragmentation Premise (Chapman 2007, 8–10): »objects were often deliberately fragmented and the resulting fragments were often re-used in an extended use-life ›after the break«.

In the same year, Chapman was invited to write a chapter on fragmentation in past landscapes by Bruno David and Julian Thomas, the editors of a handbook on Landscape Archaeology (Chapman 2008). Writing that chapter highlighted the frequency with which the objects embodying enchainment relations across the landscape were broken objects that could have been re-fitted to fragments from the same once-complete object that were deposited in another place. Indeed, many instances of inter-site re-fitting were cited (Chapman/Gaydarska 2007). It was therefore hard to resist the conclusion that fragment dispersion across the landscape was one of the important social practices through which enchainment relations were maintained at the local and sometimes wider level. Chapman posed the question: now that more isotopic evidence is available for the sourcing of people, which often showed great mobility among prehistoric individuals, why not for things and fragments of things as well as persons? However, the fragmentation of place was not incorporated into a discussion of landscape fragmentation for more than a decade. This led to a weakness in fragmentation theory in the 2010s – its lack of a grounding in place.

The key later insight (Chapman 2022) was that an integrated theory of fragmentation depended on the inclusion of the fragmentation of place. In the simplest terms, the fragmentation of place meant the removal of material from that place for transformation into objects. Each place has its own story to tell about the production sequence of the »resources« which formed one attraction for that place. However, the »stickiness« of objects – their ability to form relational bonds to places, people and other objects – meant that it was not only the physical aspects of a place that were moved across the landscape but also the values and associations of the place as well. Richard Bradley (2000, 88) has suggested that finished products from unusual locations were not only »arte-

facts with a history of their own« but also »pieces of places« which carried their places of origin across the landscape to their places of use and eventual deposition. This is a perfect summary of the first life-stage of objects in general, which involved the fragmentation of the landscape in order to retrieve the »raw material« for the making of »complete« objects from increasingly incomplete places. A complementary idea is the general principle enunciated by Chris Gosden (2009, 182) that »values attached to materials and to place are mutually referential and supportive«.

It may seem at first sight that the fragmentation of place is a rather different practice from the breaking of objects or the fragmentation of the human body. However, it is through the intertwined processes of enchainment and *synecdoche* that we can make a direct comparison between the fragmentation of objects and the fragmentation of places. To answer the Monty Pythonesque question »What has place-fragmentation ever done for us?« depends on the extent of commitment to the object biography approach or its alternative of itineraries. Insofar as the origins of objects are related to the fragmentation of place, it would be impossible to trace an even partial itinerary of an object without taking its origin into account (Chapman et al. 2023).

The earlier position (Chapman 2008) that fragmentation becomes part of landscape archaeology when we map fragment dispersion onto places is now considered insufficient. Instead, landscapes become the network of places where complete object biographies were discontinuously performed, from their creation in an initial act of place-fragmentation to their movement across the landscape to other places and their eventual deposition, sometimes in yet another place. The claim is that the place of deposition is the culmination of entire object biographies – a celebration of all of the enchainment links created through all life-stages (Chapman/Gaydarska 2020).

In summary, this thinking led to a re-formulation of the Fragmentation Premise as follows: »Places, human bodies and objects were regularly deliberately fragmented; and the resulting fragments were often re-used in an extended use-life ›after the break« (Chapman 2024, 293). It is the links between

places and a characteristically open-ended series of other places that marks out enchainment as central to the creation and maintenance of social life. We now turn to a consideration of the mutually constituted agency of places and objects in the fragmentation landscape through a discussion of three case studies: the ground-breaking study of Bronze Age

hoarding in the Jura landscape (see Gauthier/Piningre, this volume), the analysis of a highly structured pilgrimage centred on Kavos in the Early Cycladic phase of the Aegean Bronze Age (Renfrew 2015b); and the deposition of single objects and hoards in the Copper Age of Old Europe (Chapman/Gaydarska 2020).

Hoarding in the Bronze Age of the Salins-les-Bains Region of the Jura

In this commentary, we shall not repeat the details of the innovative research project presented in Estelle Gauthier and Jean-François Piningre's chapter

in this volume but, rather, use the project results to reflect on the relationships between place, landscape and deposition. One of the most impressive aspects

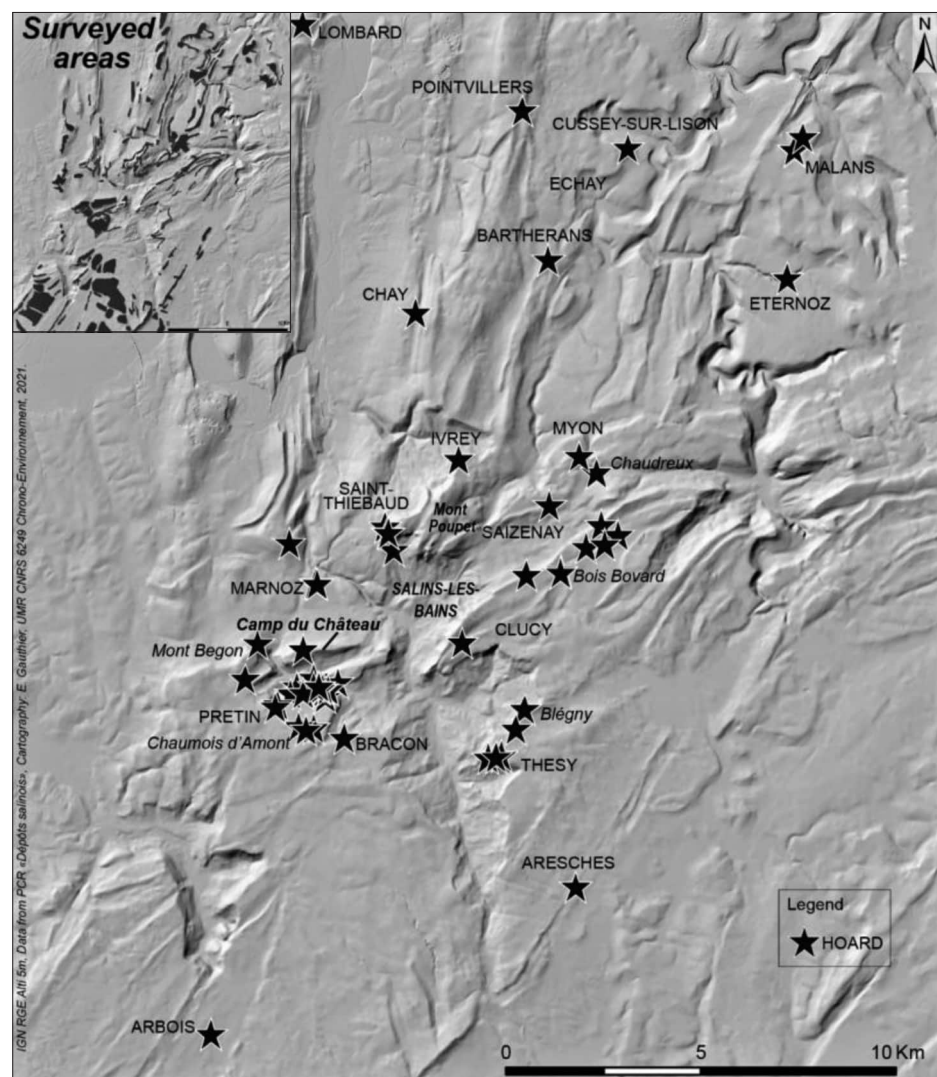


Fig. 4 General map of the discoveries in the sector of Salins-les-Bains, Jura/FR. – (After Gauthier et al. 2023, fig. 1).

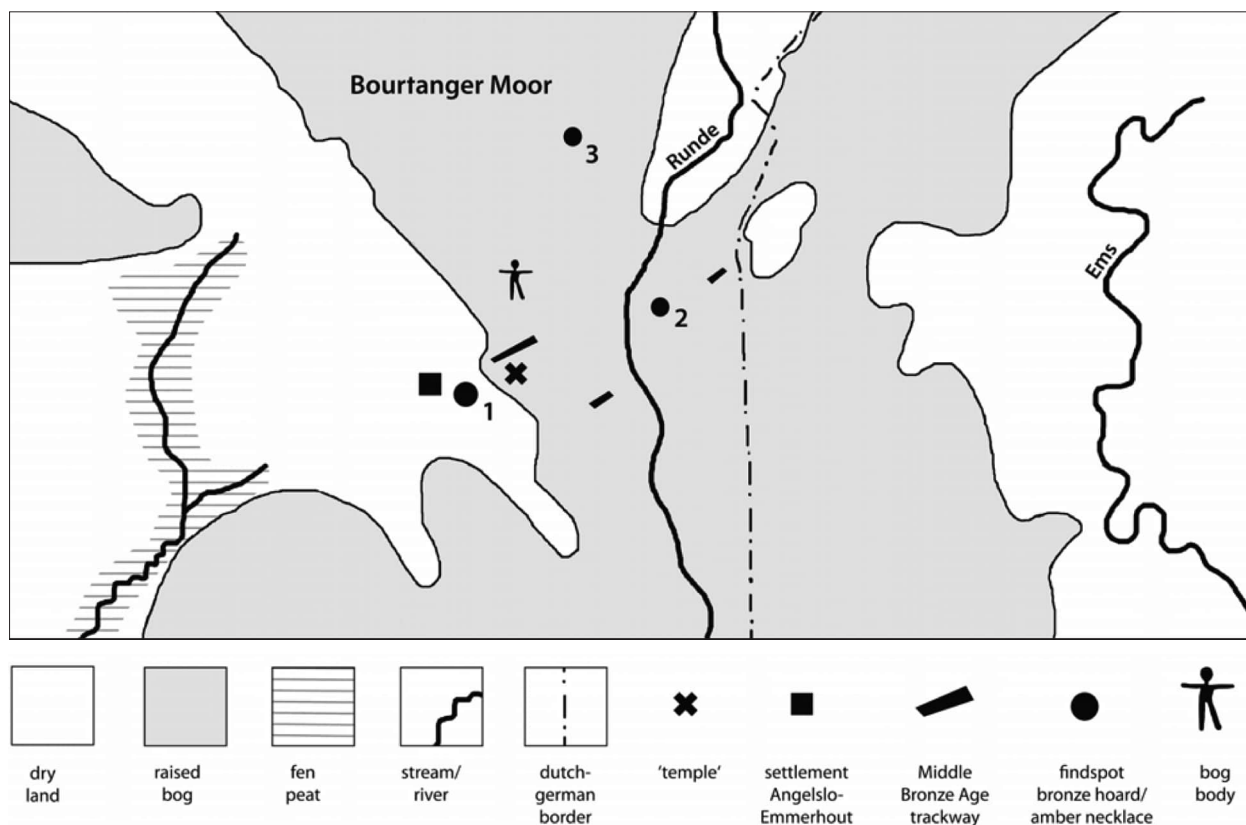


Fig. 5 Simplified distribution map of some Bronze Age finds in the Bargerosterveld area, Holland/NL. – (After Fontijn 2012, fig. 5).

of the project was the methodology of the systematic, intensive use of metal-detectors, often under the forest cover, to locate metal finds across a substantial part of the landscape. So far, the results total some 200 single finds and 85 hoards of mostly fragmented objects in a surveyed study area of 5,000 ha (Gauthier/Piningre 2025, fig. 1) (fig. 4).

The long-term deposition in the study area indicates consistent practice over centuries, if not one millennium. This is reminiscent of David Fontijn's study (2012) of the much smaller Bargerosterveld area (prov. Drenthe/NL) (fig. 5), where settlement sites were rare and which was the scene for several acts of deposition throughout the entire Bronze Age (2012, 65). Fontijn notes that, although the practice of using this area for depositions was remarkably stable, there was ample evidence that the way of life, the cultural landscape and social conditions changed considerably during the same time (2012, 65). Fontijn (2012, 61–63) further observes that the hoards

and single finds reflected a non-clustered, dispersed distribution of bronze deposits across the landscape, without an exclusive focus on one place.

In the Jura, hoards were often placed on or near the surface, hardly ever being deeply buried, and sometimes near highly visible places such as rocky outcrops. Topography was clearly an important criterion in selection of hoarding places. Gauthier and Piningre's (2025) GIS-based viewshed analysis shows an inter-visibility network over the central area, with up to 15 hoard locations visible from one of the hoarding places and interpreted as evidence for an organised system of hoards in the central area. Such a pattern of inter-visibility is an excellent example of Jones' (2007) description of landscapes as »densely packed networks of indices«, where the fragment would index an object, an event, a memory or social practice (cf. Kovacik 1999). Such indices were clearly reinforced by the long-term homogeneity of hoard contents in the study area.

The ideas of deposits as »anchors for local memory« (Edmonds 1999, 132) or deposition as »remembrance through removal« (Fontijn 2012, 77) also chime well with Gauthier and Piningre's (2025) notion of the agency of hoards as maintaining cultural memory. This last point is a reminder that hoards did not necessarily become less dynamic agents with time after their deposition.

The other agency of hoards for Gauthier et al. (2023) was their population of the landscape in the collective imagination of the Bronze Age people, keeping the memory of these places and ensuring their integration into the daily landscape. This ex-

plicit link between people and objects follows in the tradition of Marcel Mauss (1990) whose book »The Gift« is based on an exploration of the idea that things are to some extent persons, just as persons and groups behave in some measure as if they were things. Recognising that metal objects now became the **»main players«** (authors' emphasis), Fontijn (2012, ch. 4) asserts that »the burial of metalwork in the landscape had become a significant and exclusive social practice in its own right«. This is, indeed, one of the main messages from the Jura region. We await the results of re-fitting studies between different hoards and even between hoards and single finds.

The Early Cycladic Kavos Sanctuary and Maritime Pilgrimage

The largest-scale re-fitting exercise in Aegean prehistory was recently carried out in the context of the Cambridge Kavos Project. The focus of the investigations was the small island of Keros and the adjoining islet of Dhaskalio, both with intensive 3rd millennium BC activities in the Early Cycladic II period. There was a settlement on Dhaskalio while, on Keros at the site of Kavos, there was an intensive deposition of fragmentary objects, mostly pottery, marble figurines and vessels, dated between 2750 and 2400/2300 BC (Renfrew 2015b).

Three separate re-fitting operations at Kavos focussed on pottery, marble vessels and marble figurines respectively. The total of 53,639 sherds from domestic ceramic vessels included approximately half the total as feature sherds. Only two restorable vessels were found which arrived as complete at Kavos. For the most part of the assemblage, »it was brought to Kavos in fragmentary form« (Renfrew 2015a, 383). A total of 2,236 fragments of stone vessels – mostly of marble and limestone – was found, with not a single vessel re-fitted to completeness (Brodie 2015). Most of the fragments formed less than 25 % of the circumference. Only one re-fit covered more than 8 m across the site. A similar picture was found with the 553 fragments of mostly marble figurines (Tambakopoulos et al. 2015). 72 re-fits

were found, with five cases of five joining fragments, seven cases of four joining fragments, ten cases of three joining fragments and 60 cases of two joining fragments. This left the maximum number of fragmentary figurines as 511 items. Six of the 72 re-fits spanned more than 8 m of the site, with a maximum distance of 15.7 m, or half of the site.

On the basis of the re-fitting operations, Colin Renfrew (2015b) concluded that the objects had been deliberately fragmented before they reached Keros rather than being transported as complete marble bowls, figurines and ceramic vessels to Kavos followed by »local« fragmentation. Renfrew reconstructed a complex operational chain for the Folded Arm Figurines (FAFs), which he termed »a cascade of contexts«: (1) primary production on another island; (2) use in ritual display in settlements as complete objects; (3) deliberate breakage, with the fragmentation leading to a »new life« for the figurines; (4) selection of some FAF fragments for deposition in Early Cycladic cemeteries and settlements but, more frequently, for collection with other objects in a container for the maritime »pilgrimage« to Keros; and (5) deposition at Kavos of fragments of ceramic and marble vessels and FAF fragments. Ceramic petrographic analysis indicated the scale of the ritual network connecting Kavos to a further nine Cycladic



Fig. 6 Map indicating some of the sources of pottery imported to the Kavos sanctuary. – (After Renfrew 2015, fig. 7.20).

islands as well as to Corinth on the mainland, with the marble for FAFs and vessels coming from Naxos and possibly also Ios and Syros (**fig. 6**). This network covered some 350 km (Corinth – Izmir) but did not appear to include Minoan Crete.

The pilgrimage to Kavos raises a host of interesting questions concerning the relations between fragmentation, place and seascape. The pilgrimage was clearly a systematic, repeated practice carried out over several centuries (2750–2400/2300 cal BC), with enchainment of figurine fragments between Kavos and what we may term the Home Communities where the figurines originated and were used before fragmentation. Whatever the details of the ritual practices enacted at Kavos, the symbolism of *synecdoche* was central to the establishment of the identities of the ritual participants in relation to the pilgrimage centre and their own Home Communities. The objects which came to Kavos were »pieces of places« – indeed a multiplicity of places dispersed across the pilgrimage network. The *synecdoche* symbolism was reinforced by fragment curation, which could be recognised at two or possibly even three stages of the process: the Home Community, where the totality of FAF, marble and ceramic vessel fragments would have been kept until a small number

was selected for transportation to Kavos; curation during the pilgrimage; and possible curation at Kavos before ultimate deposition in the places for special deposits.

The temporality of the pilgrimage was also important, with the AMS dates for the Kavos excavations showing a duration of potentially two, three or four centuries. If a 400-year period is envisaged, the mean annual deposition of potsherds reaches 134 (perhaps 30–40 vessels), with five or six fragments of marble vessels *per annum* and one or two fragments of marble figurines *per annum*. A shorter duration could potentially double these mean annual contributions. Nonetheless, the scientific identification of up to eight sources of marble objects meant that annual ceremonies may well have attracted a limited number of deposits from a rather small number of pilgrims – hardly the point of a pilgrimage at all! These simple statistics suggest that pilgrimages may have taken place every few years to create a major event. Each quinquennial pilgrimage event could have generated the deposition of 150 ceramic vessels, 25–30 fragments of marble vessels and 5–10 figurine fragments – or several objects from each of the eight potential sources. This scenario would seem to represent a performance involving sufficient pilgrims to

make it a success; clearly, fewer performances would have increased the size of each gathering. Repetition was central to the creation of a traditional of ritual practice centred on Kavos, which excluded mortuary behaviour.

Over the centuries when it was in use, Kavos developed and changed as a significant pilgrimage place. As a small island in the Aegean, it was primarily an example of a liminal place. Fontijn (2020) reminds us that liminal places were often selected for deposition because of the ambiguity of the deposited objects and the transformative nature of deposition itself. Any object fragment was ambiguous insofar as the nature of the missing part was unknown to all but one or two specialists. The successive performances – perhaps every five years – meant that Kavos was a »multiple« place *sensu* Timothy R. Pauketat (2013): each new deposit turned Kavos into a »new« place. Indeed, places like Kavos constantly generated new people, new identities, new objects and new relationships. One long-term change may have been the fusion of deposits comprising »individual« objects into »communal« identities with corporate meanings.

In general, a pilgrimage centre such as Kavos increased the opportunities for the proliferation of relationships. To what extent such places were deliberately created to increase these opportunities is a moot point. It is worth underlining that relationality

was a key social resource – just one of the significant outcomes of enchainment.

A final observation concerns four ways of manifesting the agency of the object fragments deposited at Kavos. The first way is the way that the fragments represented the culmination of their entire biographies; the fragments embodied all of the relationships experienced during their lives. Secondly, the implication of Fontijn's (2002, 275) statement that deposition represented »a culturally prescribed and meaningful way of keeping objects apart and in the right place« is that the objects themselves embodied the dominant cultural order, as maintained by the mobilisation of the labour of division (Munro 1997). But thirdly, the fragments also symbolised the tension between keeping objects in the right place and the connections inherent in enchainment and memorialisation between deposit-places and other places. The fourth form of fragment agency is perhaps the most important. Just as Lucy S. Evangelista and António Valera (2019, 64) characterised the depositional process for the Portuguese Copper Age enclosure of Perdigões (distr. Évora/PT) as »human bones in enclosures built the strength of each enclosure«, so stone figurine and vessel fragments, as well as ceramic fragments, built the strength of each special deposit at Kavos to create a cumulatively powerful pilgrimage centre serving much of the Aegean.

The Landscape Deposition of Copper Objects in the Balkan Copper Age

In contrast to Olympia and other Classical shrines, the preponderance of stray metal finds in both the Balkan Copper Age and the European Bronze Age in general stimulated Svend Hansen (2013, 371–372) to call these finds »offerings without the temple«. In this third case study, we hope to show that, even without the temple, these deposition-places are still relevant to temples full of deposits.

In 2020, we published an article summarising research on the deposition of metal finds in the Balkan Neolithic and Copper Age (Chapman/Gaydarska 2020). Our main concern was the metal finds depos-

ited in the landscape, whether as single finds or as hoards. We argued, however, that any understanding of these finds must take account of copper objects deposited in other places – principally settlements and the mortuary domain.

Five main explanations for landscape deposition had been mooted: markers of destroyed graves or settlements, hidden objects, gifts, object loss and references to cognitive frameworks. Fontijn (2020) offered a general critique of the first four »explanations« for hoarding by emphasising that selective deposition was scarcely covered in these traditional

explanations, any more than in the prestige goods theory of hoards. An example of the fifth explanation is Mary W. Helms' suggestion that, since raw materials had been obtained from the earth, metalworkers felt it proper to return some of that metal to the earth as a way of »nourishing« the earth, sustaining the generative processes of the cosmos and perpetuating an ordered and active social life (Helms 2012, 107). Helms understands deposition as »carefully planned expressions of notable human activities, chiefly and otherwise, purposely intended to manipulate cosmic processes for the ultimate benefit of human communities« (2012, 110).

To his question »was there a pre-Bronze Age »metallization« of depositional practices?« in Old Europe¹, Fontijn (2020, ch. 4) answered positively, noting the increase in the number of hoards and the creation of many new metal valuables, which increasingly came to dominate certain depositional contexts. Recognising that metal objects now became the »main players«, Fontijn asserted that »the burial of metalwork in the landscape had become a significant and exclusive social practice in its own right«. The significance of landscape deposits – whether single-item or hoards – cannot be underestimated in Old Europe, with such deposits comprising 80 % of all depositional findspots. Such deposits were made in each landscape unit – wetlands (riverine or marshy zones in the lowlands), lowlands themselves (generally areas of moderate to high arable potential), hill-country (generally the transition zones between lowlands and uplands), upland areas and rocky areas (specifically rocky landscapes, usually in the uplands). As we shall see, their contents are predominantly heavy tools.

The fundamental change in the mid- to late 5th millennium BC concerned the transformation from the traditional Old European basis for enchainment relations through fragmented objects (Chapman 2000) to the emergent properties of the smelting, melting, alloying, re-melting and re-cycling of molten metal (Taylor 1999). These properties not only offered ways

of creating larger, heavier objects such as massive shaft-hole axes but also created the potential for the formation of new objects from old, perhaps combining two or more different metal sources. Re-cycled copper would have offered a new form of shorthand for complex biographies. If this opportunity was realised, then it was not only the impressive physicality of large copper objects that made them so important but also their compressed biographical information that demonstrated wider political links to their social hinterland. In this way, the fusion of biographical knowledge and special technical skills opened up the possibility for impressive copper-alloy objects to become inalienable objects *sensu* Maurice Godelier (1999), in a way that could not have happened with small copper objects, single-source large axes or most chipped stone objects. The key object types for these transformations became the copper axe and the chisel, whose inalienability was assured through deposition in an invisible but memorialised place. However, the choice to reverse the direction of this accumulation of copper objects in a single object was the decision to fragment. The technical difficulties of breaking a heavy copper-alloy axe (see Knight, this volume) meant that deliberate practices can be invoked to account for these fragments dispersed across the landscape. But to what extent was the fragmentation of metal objects part of that social practice?

A substantial, if minor, component of the over 1,500 deposits (8–9 %) consisted of fragmented tools – almost all of them axes. These fragments were most frequently placed in landscape deposits (up to 80 %) in the lowlands, while none was deposited in mortuary contexts. To our knowledge, no two fragments from the same tool have been re-fitted from the same site or different sites (Chapman 2000; Chapman/Gaydarska 2007), suggesting that the enchainment links between axe and chisel fragments may have formed a network connecting deposits »out there« in the landscape to other deposits as well as to nearby settlements. This would appear to be a parallel for the Jura uplands practices (see above).

¹ The term »Old Europe« was developed by Marija Gimbutas to characterise regions in South-east and Mediterranean Europe dominated by settlement sites containing rich ritual assemblages, especially of figurines. Old

Europe covers Greece, southern Italy, Bulgaria, North Macedonia, Serbia, Montenegro, Bosnia and Herzegovina, Croatia, Hungary, Romania, Moldova and Ukraine (Anthony 2010).

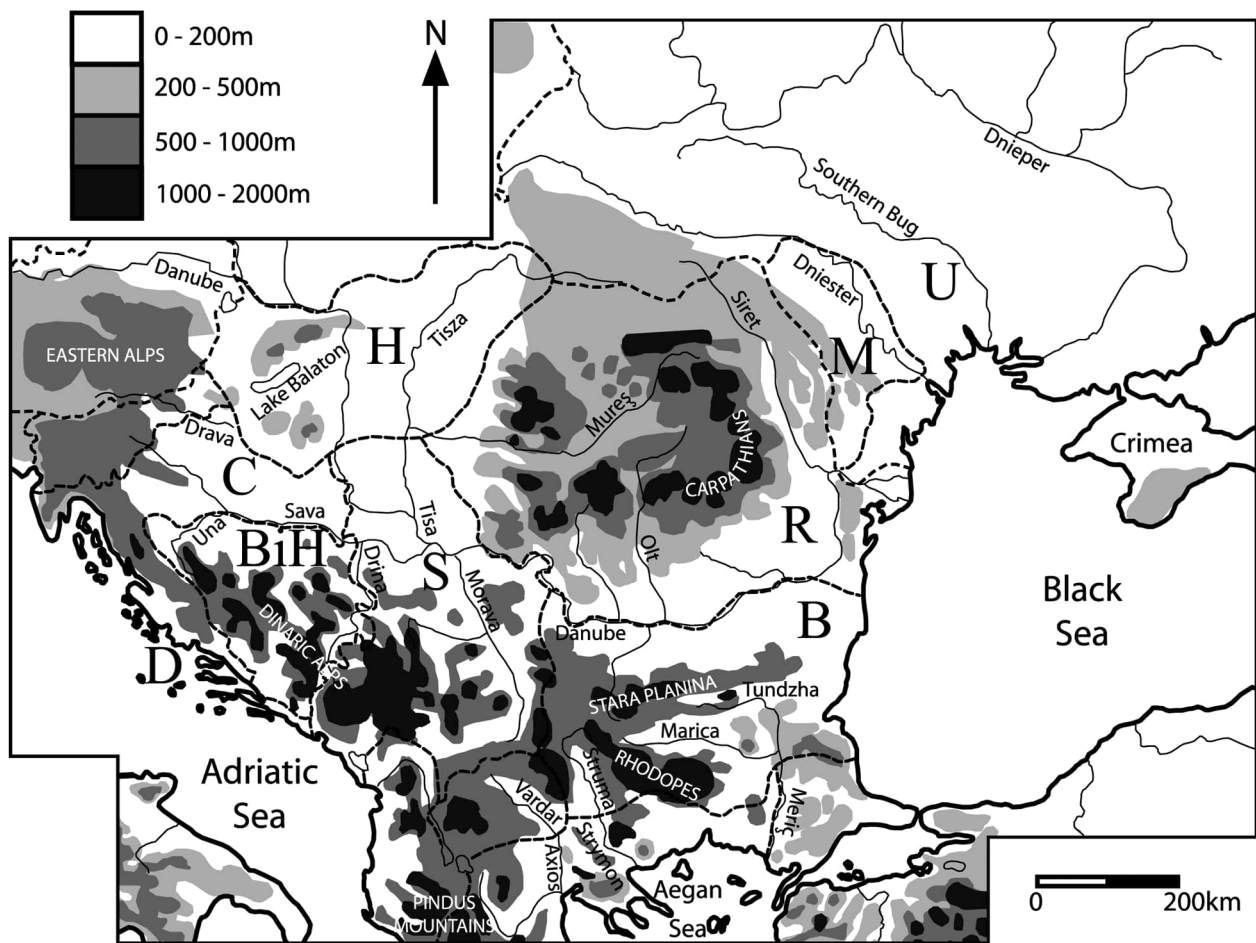


Fig. 7 Map of Balkan Copper Age study regions. – (Graphics L. Woodard).

In a new analysis presented here, we attempt to refine our understanding of the role of metal fragments in Balkan Copper Age deposition (fig. 7). In this study, one of the six original regions – Croatia, Dalmatia, Bosnia and Hercegovina – was omitted because of small sample size and the rarity of fragmented objects. The sample was further reduced to the three principal axe types – hammer-axes, shaft-hole axes and flat axes (fig. 8) – because of the rarity of fragmented objects in the other types (e. g. awls, chisels, daggers and Banyabik axes). Their finds locations were divided into a simplified set of three landscape zones condensed from the five used previously – lowland zones (lowland and wetland), hill-country and upland zones (upland and rocky). The finds were classified according to the contexts used in the earlier study – landscape deposits (depos-

its made beyond sites and monuments), settlement deposits and mortuary deposits (grave goods).

How did the practice of deliberate fragmentation of copper objects fit into this picture of regional depositional variability? The first and most significant point is that, in contrast to ceramic fragmentation (Chapman 2000), fragmented metal objects did not appear as grave goods in any of the five regions. There was also a paucity of metal fragmentation in settlement contexts – indeed none has yet been recognised in Serbia, Hungary or Moldova – but with some examples of fragmented hammer-axes and flat axes in Romanian and even more in Bulgarian settlements. Variable fragmentation practices were found in landscape deposition, with some fragmentation of all three main axe types in Serbia and hammer-axe and shaft-hole axe fragmentation in Romania. In

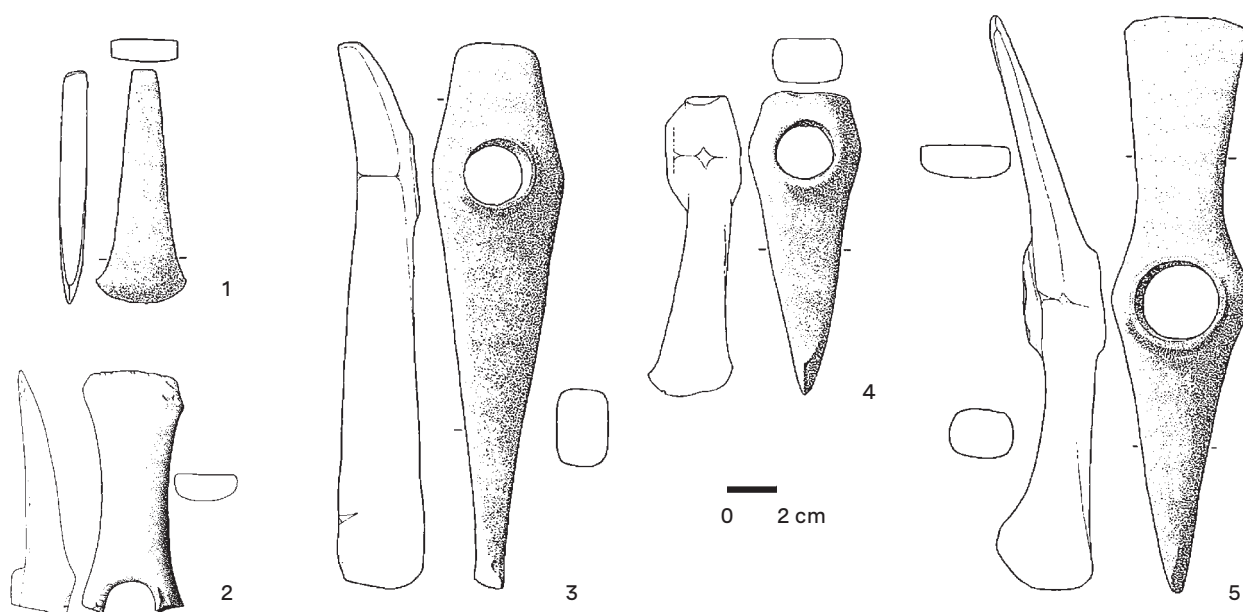


Fig. 8 Types of copper axes included in the study: **1** Flat axe, Egerszalók (Heves County/HU). – **2** Fragmented shaft-hole axe, Mezőberény (Békés County/HU). – **3** Hammer-axe, Kisköre (Heves County/HU). – **4** Fragmented hammer-axe, Szob (Pest County/HU). – **5** Shaft-hole axe, Szarvas (Békés County/HU). – (1–5 after Patay 1984, pls 4, 54; 9, 156; 30, 344; 48, 498; 51, 525; graphics B. Gaydarska). – Scale 1:3.

Hungary and Bulgaria, fragmentation was limited to the shaft-hole type, with moderate frequency in Hungary and far less common occurrences in Bulgaria. No landscape fragmentation is yet known from Moldova.

Fragmentation practices varied according to the main three axe types, with flat axe fragmentation known only in one case in the entire study region – at Zlatitrap Mechkjur (distr. Plovdiv/BG) (Todorova 1981, 31). Fragments of hammer-axe were deposited on their own in Serbia and Bulgaria and there were two cases of mixed hoards of a complete and a fragmentary hammer-axe in Romania (Vulpe 1975). The greatest variety of combinations was found with the shaft-hole axe type, with fragments occurring on their own in Hungary (a remarkable 26 cases or 24 %) (Patay 1984), Serbia (11 cases), Romania and Bulgaria; a multiple hoard consisting of two fragments of the same axe with a fragment from another axe at Satchinez (Timiș County/RO) (Vulpe 1975, 44); mixed hoards of complete and fragmentary axes in two large hoards in Bečmen (Belgrade/RS) and Baranda-Trnovača (distr. South Banat/RS) (Antonović 2014, 50, 66); and even a fragmentary axe in the Kikinda – Livade hoard (distr. North Banat/RS), associated with a variety of object types, including chisels and a flat axes (Antonović 2014, 34). These

instances indicate the variety of enchainned links created in the landscape through copper axe fragmentation.

Finally, we turn to the landscape context to consider the various ways in which axe fragmentation may have impacted the lowland, hill-country and upland zones. There was a far greater diversity of combinations in the lowland zone than in the other zones but it is important to note that similar practices occurred in the upland zone too, with the difficulties of recovering upland data perhaps a factor here.

The lowland zone showed a range of single axe-fragment deposits, whether hammer-axes in Serbia, Romania and Bulgaria or shaft-hole axes in all 26 cases in Hungary and also in Serbia (9 cases). The lowland zone was the place for the deposition of complex shaft-hole axe hoards, as in the two hoards of complete and fragmentary axes and the axe fragment with other metal types in Serbia, or the hoards of complete and fragmentary axes in both Romania and Hungary.

Communities depositing single axe-fragment hoards in the hill-country zone showed a preference for shaft-hole axes (Serbia, Romania and Bulgaria) over hammer-axes (only in Serbia) and there were only two cases of a mixed hoard of complete and fragmentary axes, both in Romania – a hammer-axe

hoard in an upland rocky area at Sic (Cluj County/RO) (Vulpe 1975, 27) and a shaft-hole axe hoard at Voia (Hunedoara County/RO) (Vulpe 1975, 42).

Any attempt to interpret these complex findings should focus on the lowland zone – the places where the largest number of fragments of copper tools was found and the places with the widest range of fragment combinations. Lowland arable areas were once »natural«, uncultivated places but may have been, or had the potential to become, cultivated and altered through agricultural practices. Lowland axe deposits were thus related to the extension of the cultural domain typical of settlements through the creation of new networks of invisible, yet memorialised, places in cultivation zones. The finding that all 26 stray finds (single-item deposits) of fragmentary axes in the Hungarian lowlands were shaft-hole axes rather than hammer-axes or flat axes is a rare example in the Copper Age of Fontijn's (2002, 275) characterisation of deposition as »a culturally prescribed and meaningful way of keeping objects apart and in the right place«. Since there are currently no known examples of fragmentary shaft-hole axes in coeval graves or even settlements, it seems probable that the missing fragments may have also been deposited in the landscape, minimising the tension between

the cultural order and different deposition-places. These »anchors for local memory« created their enchainment networks across the fertile plains, indexing a wide variety of significant deposit-places with multiple enchainment links to domestic and mortuary domains. The discovery of the majority of »Balkan« landscape deposits as complete or fragmentary copper tools placed in fertile arable land in the lowlands emphasises the multiple links between deposition, social transformation, tenure and mixed farming. In Helmsian terms, the deposition of metalwork to sustain the cosmic processes essential to social reproduction was largely focussed in the areas where arable production sustained local dwelling. The deposition-places of these fragmentary axes symbolised the culmination of their entire biographies, presencing places as varied as their upland copper sources, the settlements whose communities exchanged the axes and the more local places where the performance of fragmentation itself created new enchainment networks of people, places and objects. Perhaps only a small, select company was present for the deposition of these fragmentary axes in secluded, semi-private or semi-public places – the kind of liminal places which would have been suitable for such ambiguous objects.

Discussion

In this chapter, we have travelled some distance from Borges' abominable mirrors to the fragmentation of place via, *inter alia*, the Great Hungarian Plain, the Cycladic islands and the Jura Mountains. We suggest that the outcome of this voyage is a new and compelling synthesis of fragmentation studies which integrates the multiple persons, places and objects which now constitute the coinage of the debate. These varied facets of each entity are indeed the result of the multiplication of the universe to which Borges referred. In this fluid and dynamic version of fragmentation practices, we highlight the significance of enchainment as the most general way in which relations were created in the past. A key outcome of enchainment was relationality – the condi-

tion of creating links between persons, places and objects. It was inherent in fragmentation that relationships were created by the division of all of these three entities into parts from wholes. The notion that a whole is a relational phenomenon follows from the central tenet of assemblage theory (Bennett 2010) that everything is a part of a wider whole. On this basis, we can recognize fragmentation in persons through bodily division, in places where the landscape is affected by division and in objects where an overall commonly accepted design is changed by division. The inclusion of place into the earlier version of the Fragmentation Premise leads to the re-formulation that »Places, human bodies and objects were regularly deliberately fragmented; and the resulting

fragments were often re-used in an extended use-life »after the break« (Chapman 2024, 293). A key aspect of the fragmentation of persons, places and objects was the agency of each entity – not only personal agency. A general insight from each of our three case studies is the mutual constitution of place-agency and object-agency through deposition in the landscape. This is because places can be conceived of as stages for the performative aspects of fragmentation practices, which generated new persons, new identities and new relationships as well as maintaining existing ones. We propose that, within the overall framework of enchainment with its outcome of relationality, there are three general forms of combined place- and object-agency. These are the multiplication of the universe, the embodiment of biography and the exemplification of key cultural principles.

We begin with Borges' notion of the multiplication and dissemination of the universe, which could hardly have been more apt for fragmentation practices if Borges had tried. The principle of *synecdoche* – the part standing for the whole – implies multiplication of the »original« whole through fragmentation. This was just as true for places, through the removal of »resources« for further usage at (an)other place(s), leaving much of the original place intact. While much has been made of the way in which this practice created, in Bradley's memorable phrase, »pieces of places«, less attention has been paid to the reciprocal effect of the movement of resources on the place of origin. The further the pieces of place moved, with an increasing diversity of links to other persons, places and objects, the greater the repute of the place of origin. Thus the Welsh bluestones (Parker Pearson et al. 2021) became symbolic of the building of one phase of Stonehenge, gaining in local significance as the source of one of the most dramatic monuments in North-West Europe. The same process can be seen with objects. Thus the marble folded-arm figurine produced on one Cycladic island, broken and with one part joining the pilgrimage to Kavos, was multiplied and dispersed through networks of linkages across the entire Aegean Basin. These networks of linkages indexed not only the folded-arm figurine broken into two parts on two Cycladic islands but also all the other figurine fragments deposited on

Kavos as well as the fragments which remained in their Home Communities as well as the other object types – fragments of pottery and marble vessels – placed in the Kavos sanctuary but also the complete forms of these three object types found anywhere in the Aegean Basin. These networks also indexed the other places in which the complete or fragmentary objects were made, used and deposited. These connections would have sustained the pilgrimage to Kavos over the two to four centuries in which it was in existence, creating a cumulatively dense network of indices that was ripe for political exploitation.

We next consider the embodiment of biographies. A classic example of the importance of biographies to exchange practices was cited by Nancy D. Munn (1986) in her study of the Melanesian *kula* ring. She recognised that the fame of an exchange participant was as dependent on their history in the shell ring exchange as the fame of a shell ring depended upon the persons who had »owned« the ring throughout its own history. The basic principle here is the concept of »presencing« (Chapman/Gaydarska 2010) – one of the key aspects of place- and object-agency, by which a piece of place at a remote settlement presenced the origin of the material, a small set of beads presenced the entire necklace from which the subset was fragmented or a heavy copper tool presenced the two smaller tools which had been melted down and re-cast to create a »new«, inalienable object. In all of these examples, earlier biographical information was consolidated into a new form which was as important to the value of the novel entity as its material, design or ornamentation. The continuing interaction of persons who know the biographical details of an object or a place and the object or place itself make it possible to summarise the entire biography in special events, such as deposition (for an object) or further place-fragmentation (for a place). While personal or communal memory was undeniably important in the invocation of a complete biography of a place or an object, such an invocation could not have been created without the agency of the place or object (cf. Bruno Latour's [1999] discussion of the gun and the gunman). Equally, the wealth of biographical detail would have affected the significance of the deposition of an object (Fontijn 2020) or the renewed

fragmentation of place for further resources. The contribution of a significant object to a place would have built the strength of each deposit as well as the importance of the depositional-place itself. Repeated depositions at places such as the Kavos pilgrimage centre or the Classical temple at Olympia would have created a cumulatively powerful focus for those able to exploit such a conjuncture. In all cases, an important aspect of the agency of places and objects was their anchoring of local memory (Edmonds 1999) through repetition, so that continuity of memory formed a local and perhaps wider cultural tradition. Gauthier and Peningre (in this volume) highlight a dynamic side to this anchoring by showing how bronze landscape hoards populated the landscape in the collective »imagination« (authors' emphasis) of local Bronze Age communities. The embodiment of biographies was potentially one of the most significant aspects of object- and place-agency.

We now turn to the ways in which objects and places exemplify key cultural principles. One of the geographers interested in »rubbish«, Rolland Munro (1997), has shown how much effort it took to ensure that cultural and natural materials are distanced one from each other and how »rubbish« is also separated from other deposition. Munro coins the term »the labour of division« to denote the care with which objects are treated to manifest these cultural principles. This line of reasoning is echoed in Fontijn's (2020) conclusion that deposition could promote the maintenance of cultural order by the repetitive placing of object types in the same, appropriate context and the avoidance of other inappropriate contexts. A good example of spatially-based cultural order comes from the Hungarian Copper Age. While fragmented pottery was commonly found in graves (e.g. the Tiszapolgár-Basatanya cemetery [Hajdú-Bihar County/HU]) (Chapman 2000, 51–53) but fragmented copper axes were absent from mortuary contexts (Chapman/Gaydarska 2020), the converse was true for landscape hoards, which contained no sherds but often fragmented copper axes. We can recognise the demonstrable agency of pottery and copper in their contrasting depositional contexts. However, there was a tension between the diametrically opposed placing of copper and pottery fragments in different

contexts and the enchainment of objects and places in a citational network (see above).

Helms (2012) has identified ways in which objects and places supported a second form of cultural order in the manipulation of cosmic processes through deposition. The example that Helms gives concerns metal ores extracted from the earth. Metalworkers felt it proper to return some of that metal to the earth as a way of »nourishing« it, sustaining the generative processes of the cosmos and perpetuating an ordered and active social life (2012, 107–110). This is one way of understanding the landscape deposition of so many copper axes in the Balkan Copper Age (Chapman/Gaydarska 2020). However, a second principle concerns the high proportion of complete and fragmentary copper axes in Hungary which have been placed in lowland arable land rather than in nearby settlements or cemeteries. The deposition of axes in fertile areas created links between deposition, tenure, mixed farming and ultimately social transformation. Just as deposition and social transformations sustained cosmic processes, so land tenure and mixed farming sustained dwelling in the local area. In this example, there is an inextricable link between object deposition and the place of deposition, with the mutual constitution of place and object through their inter-linked agencies.

We hope that this discussion has shown that the closely related aspects of place- and object-agency were indeed as important to cultural lifeways in the past as personal agency, as performed through multiple persons, biographies and cultural order. The brevity of our comments on personal agency certainly does not mean that we downplay its significance – merely that it was important to elaborate on the often neglected performances of object- and place-agency. We do, however, feel that the movement of deceased persons from their places of death to central mortuary congregation sites has been neglected in European prehistory (Gaydarska/Chapman forthcoming). It is only when our accounts of past lifeways present a balanced and integrated narrative of all three forms of agency that we can reach satisfying conclusions about practices covering the whole-life biographies of persons, places and objects.

Conclusions

In this chapter, we have ranged far and wide across the research field of fragmentation studies in an attempt to integrate more fully than we have done elsewhere the three roles of persons, places and objects in past practices. We offer four brief conclusions, beginning with Borges.

It turns out that Borges' notions of the multiplicity and dissemination of the universe is ideally suited to the practices of fragmentation of persons, places and objects and their dispersal across the landscape. Since fragmentation is inherently a relational practice, it is a key way of developing relationality as a key social resource.

It is only when we integrate places – whether giving materials or receiving deposits – into fragmentation studies that we can formulate a more rounded research framework. This has led to the re-formula-

tion of the Fragmentation Premise as »Places, human bodies and objects were regularly deliberately fragmented; and the resulting fragments were often re-used in an extended use-life ›after the break‹«.

We have outlined three aspects of the inter-linked agencies of places and objects which demonstrate the significance of agency of entities other than the personal: (a) the multiplication and dissemination of the universe; (b) the embodiment of biographies; and (c) the exemplification of key principles of cultural order. These aspects offer a powerful statement of the range and significance of place- and object-agency that we cannot ignore in prehistoric research.

We consider the landscape to be a (dis)continuous site for the deposition of complete and fragmentary objects – all with their own agencies – on and between settlements and mortuary sites.

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Bronze Age Hoards and Greek Sanctuaries: The Example of Olympia

Sacrificial and Dedicatory Practice in Early Olympia*

ABSTRACT

At the sanctuary of Olympia, two substantial layers of blackened earth mixed with ashes, charcoal and animal bone fragments were detected in the north-western section of the Altis and in the south-eastern area of the sanctuary, respectively. While the former, known as the *schwarze Schicht* since the 1875–1881 excavations, can be linked to the cult of Zeus from the Protogeometric to Early Archaic periods, the latter is associated with an early altar of Artemis. The present paper examines the sacrificial and dedicatory practice at these two discrete cult foci, arguing that the dedicatory material of the Geometric and Archaic periods found in the area of the Artemis altar is generally similar to that connected with the cult of Zeus in the Altis. Only from around 500 BCE, with the appearance of numerous terracotta figurines and protomes, did the dedicatory practice at the Artemis altar assume a more distinct shape, probably reflecting the increased prominence of female worshippers in the cult.

KEYWORDS

Olympia | Zeus | Artemis | black layer | dedication

Located in the western Peloponnese in the lower valley of the River Alpheios, the extra-urban sanctuary of Olympia occupies a strategic location at the crossroads of important regional routes¹. These routes connected not only the Elean plain in the north with Triphylia, Messenia, and Laconia in the south and southeast, but also the coastal zone to Arcadia in the interior via the river valley. In the area of Olympia, a ford across the Alpheios mentioned by Pindar facilitated the crossing of the river². Olympia therefore held a central position within the wider region from the very beginning of its existence as a sanctuary³. It is obvious that the location of Olympia is deeply intertwined with the early sanctuary's function as a regional meeting place⁴.

The nucleus of the cult place, the so-called Altis, the sacred precinct of Zeus, developed in a small alluvial plain not far from the confluence of the Kladeos stream with the Alpheios. The Altis is situated at the southern foot of the conical Kronos hill, which constitutes an important landmark in the lower valley of the Alpheios⁵. An Early Helladic tumulus situated inside the Altis and still partially visible during the final phase of the Late Bronze Age is likely to have been the initial focus of the post-Mycenaean cult that developed into the known cult of Zeus in the historical period⁶. Based on the earliest pottery from the area of the prehistoric mound, this cult can be traced back to the decades around 1050 BCE, in other words during the transition from the Submycenaean period to the Early Iron Age⁷.

* I am grateful to John Chapman and Stefanie Kennell for improving the English text. All remaining errors are my own.

¹ Taita 2001, 118–129; 2009, 375–376.

² *Pind. Ol.* 1, 92; 2, 12–13. Cf. Taita 2001, 127–128.

³ The role of early Olympia as a central place (»Zentralität des Heiligtums«) has recently been emphasized also by Gehrke 2020, esp. 269.

⁴ See e. g. Morgan 1990, 29; Eder forthcoming.

⁵ Taita 2009, 376–377. For reflections of the local physical topography in Pindar's account of the sanctuary's foundation by Herakles in *Olympian* 10, 43–51, see Eckerman 2013, 27–28. 31; Eder et al. 2019, 162.

⁶ Kyrieleis 2006, 61; Taita 2009, 377–379.

⁷ Eder 2006, 197.

At Olympia, two substantial strata of blackened earth mixed with ashes, charcoal, and animal bone fragments were detected in the north-western section of the Altis and around the altar of Artemis in the south-eastern area of the sanctuary, respectively (**fig. 1**)⁸. In addition to these organic remains, both black layers contained abundant pottery and dedicatory material, with partly overlapping chronological ranges. A brief examination of the various classes of

offerings associated with the two cult foci will hopefully contribute to a better understanding of the dedicatory practice in early Olympia⁹ and shed some new light on the chronological relationship between the cults of Zeus and Artemis. Furthermore, drawing on the example of the metal tripod cauldrons dedicated at Olympia, I wish to demonstrate how closely intertwined the sacrificial and dedicatory practices of these two cults were.

The Black Strata in the Altis

Black layers of earth mixed with ashes, charcoal, fragments of animal bones, pottery sherds, and numerous offerings were already encountered throughout the north-western Altis during the first German excavations from 1875 to 1881¹⁰. Extending around the prehistoric mound, the so-called *schwarze Schicht(en)* expanded north and northeast to the area of the later temples of Hera and Meter (**fig. 1**). Since the black strata continued underneath the foundations of the Heraion, the construction of this temple provides a *terminus ante quem* for the formation of these layers¹¹. Containing large amounts of sacrificial debris and offerings, the black layers clearly reflect cult activity taking place over a prolonged period of time.

For the most part, the early excavators described the *schwarze Schicht* in the north-western part of the Altis as a uniform layer without any apparent further stratification. Only in some areas, for instance around the prehistoric wall structures immediately

northeast of the tumulus, were two strata of blackened earth separated by a layer of sand observed¹². Both the considerable thickness of the black layers and the particularly dense concentration of finds around the above-mentioned prehistoric walls led the excavators to assume that the architectural remains were part of the earliest ash altar of Zeus¹³. This idea has recently been revived by Helmut Kyrieleis in his seminal book on the early phases of the sanctuary¹⁴. The vast extension of the black layers in the area between the tumulus and the later Heraion can be explained by periodic levelling of the sacrificial debris and offerings which had accumulated in the altar area. During a large-scale spatial reorganization of the sanctuary in the decades around 600 BCE, the altar debris may have been spread widely over the north-western area of the Altis, while the ash altar of Zeus was relocated to its later position east of the Pelopion and the Heraion¹⁵.

⁸ For a general overview, see Bocher 2015, 50–54. 58.

⁹ Völling (2002, 88–108) gives an excellent general account of the dedicatory practice at Olympia. See also Bocher 2013 and Frielinghaus 2013 for the Geometric and Archaic periods, respectively.

¹⁰ Furtwängler 1890, 2–4; Kyrieleis 2006, 27–35.

¹¹ Kyrieleis 2006, 51.

¹² Furtwängler 1890, 2: »Es waren hier zwei tiefschwarze Aschenschichten zu unterscheiden. Die unterste, welche ca. 20 cm Stärke hatte, lag beim Pelopion etwa 1 m unter der Wasserrinne, welche außen an der Umfassungsmauer des Pelopionshügels entlang läuft. Etwa 30–45 cm höher,

durch eine Lage von gelbem Sand geschieden, lag die zweite tiefschwarze Aschenschicht, auch diese voll von alten Votiven. Die beiden Schichten näherten sich indess vielfach und gingen stellenweise in einander über.«

¹³ Furtwängler 1890, 2: »Nun erst zeigte sich der Rest des aus Mergelkalk und Feldsteinen bestehenden Fundaments des großen Altars, welchen der Situationsplan zwischen Heraion und Pelopion in unmittelbarer Nähe des letzteren gibt. [...] Rings um den Altar wurden die primitiven Votivtiere massenweise gefunden.«

¹⁴ Kyrieleis 2006, 35–47.

¹⁵ Kyrieleis 2006, 47–55.

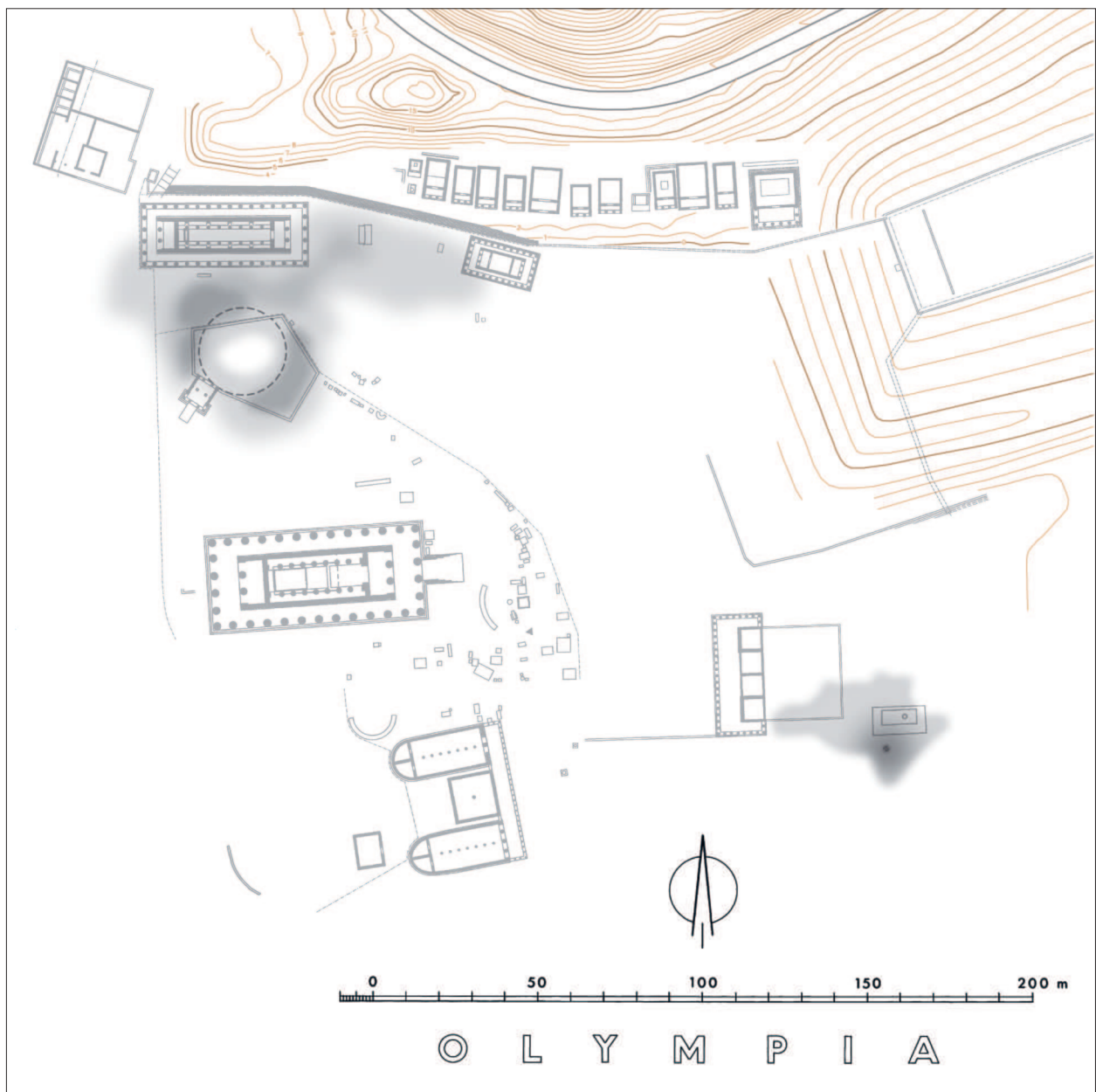


Fig. 1 Plan of the early sanctuary of Olympia (later structures in grey) with the black strata in the area of the prehistoric tumulus (north-west) and the altar of Artemis (southeast). – (Plan H. P. Birk; graphics J. Engelhardt).

Sacrificial Ritual and Feasting at the Altar of Zeus

The pottery from the black strata in the north-western section of the Altis dates from the 11th to the late 7th or early 6th centuries BCE. These layers thus testify to cult activity during the Submycenaean, Proto-geometric, Geometric, and Early Archaic periods¹⁶. The earliest pottery finds from the Pelopion excavations carried out by Helmut Kyrieleis from 1987 to 1996 include a number of Submycenaean and Protogeometric *kylikes*¹⁷. Whereas the few *kylikes* with plain stems date to the final Mycenaean phase, the *kylikes* with ribbed stems can be assigned to the Protogeometric period¹⁸. Other Protogeometric drinking vessels include cups with conical feet and vertical handle(s) as well as *skyphoi*¹⁹. Yet, we should note that in Western Greece the Protogeometric phase lasted much longer than, for example, in Attica, reaching well into the 8th century BCE²⁰. Large open vessels, such as kraters, remain conspicuously rare in the Pelopion assemblage throughout the Early Iron Age²¹. The same applies to closed shapes such as amphorae, jugs, juglets, and *pyxides*²².

The predominance of small open vessels likely indicates ritual drinking (of wine) and, possibly, the consumption of food²³. Since the practice of drinking wine diluted with water continued from the Mycenaean period without interruption into historical times²⁴, one wonders, given the scarcity of preserved Early Iron Age ceramic kraters from Olympia, which vessels were used as mixing bowls for wine and water. Could this function have generally been served by metal tripod cauldrons, as a passage in Athenaeus suggests²⁵?

The abundant residues of fire and the numerous fragments of animal bones from the black strata are indicative of burned animal sacrifices. However, the available animal bones from Kyrieleis's excavation do not provide straightforward evidence for the consumption of meat²⁶. Two representative samples from undisturbed portions of the black layer have been examined by Norbert Benecke²⁷. From area P 16, situated close to the north-eastern corner of the later *temenos* wall of the Pelopion²⁸, an assemblage of nearly 800 animal bones and teeth has been analyzed. In addition to a high degree of fragmentation, a large number of the animal bones shows traces of burning. Apparently, all body parts of the animals were present, but cut and chop marks seemed to be absent. In the few cases where the age of the animal could be determined (only sheep/goat), the bones belong to adult and sub-adult specimens. Only for 172 fragments could the species be identified. The animals included mainly sheep and goats (55 %), but also cattle (34 %) and pigs (9 %). Based on the nature of the osteological evidence, Benecke concluded that the animals were completely burned on the altar (holocaust sacrifice)²⁹. However, basing such a far-reaching conclusion on a comparatively small sample of severely fragmented animal bones would be unwise. The fact that some of the bones do show no traces of burning may in fact indicate that parts of the animals were prepared by boiling and consumed on the spot. Julia Taita assumes that regular *thysiai* may have been preceded by holocausts as opening rites; this idea remains speculative³⁰. The

16 For the latest pottery finds, see Kyrieleis 2006, 47–48. 51–53.

17 Eder 2006, 215–217 nos 1–22 pls 52–53. 76–77.

18 Eder 2006, 145–154.

19 Eder 2006, 217–222 nos 23–90 pls 54–58 (cups); 227–228 nos 150–156. 158–161 pl. 62 (*skyphoi*).

20 Eder 2006, 195–196.

21 For the few fragments of kraters, mainly dated to the Protogeometric period, see Eder 2006, 238–240 nos 292–302 pls 67–69. 79–80.

22 Eder 2006, 240–243 nos 304–342 pls 69–71. 80.

23 Eder 2006, 202–203. Morgan (1999, 322–323) convincingly argues that small open vessels might have been used as food bowls. In the sanctuary of Zeus on Mt. Lykaion (Arcadia/GR), drinking vessels are likewise predominant during both the Mycenaean period and the Early Iron Age (Romano/Voyatzis 2014, 628; 2021, 4. 22).

24 Bruns 1970, 24. 44; Sherratt 2004, 325–326.

25 Ath. *Deipn.* 2, 37 f–38 b. Bruns 1970, 38. For the use of Archaic bronze (protome) cauldrons standing on rod tripods or conical stands as mixing vessels, see e. g. Gauer 1991, 4–5. Herodotus (4, 152, 4) referred to the protome cauldron dedicated by Kolaïos at the Samian Heraion as κρατήρ.

26 The animal bones found during the early excavations were not kept.

27 Kyrieleis 2006, 43–44; Benecke 2006a. Cf. Bocher 2015, 55–56; Taita 2015, 130–132.

28 Kyrieleis 2006, 22–25.

29 Benecke 2006a, 247: »Das Tieropfer selbst bestand im Verbrennen wohl vollständiger Tierkörper jener Arten.«

30 Taita 2015, 131 with note 77. Cf. Ekroth 2008, 89–90.

animal bones from area P 28 at the eastern edge of the prehistoric tumulus³¹ were even more heavily fragmented than the material from area P 16, typically measuring only a few millimeters. As a result, the body parts or species of the animals could not be identified. The vast majority of the fragments (95 %) was calcined. The extremely high degree of fragmentation supports the assumption that the bones were intentionally crushed before deposition³².

Given the very high percentage of calcined bone fragments, the osteological material recovered from area P 28 may be interpreted as altar debris, that is, the remains of (parts of) the sacrificial animals burned on the altar³³. The bone assemblage from area P 16, on the other hand, cannot readily be identified as an altar deposit, even though most of the bones show traces of burning and butchering marks are apparently absent. However, the high proportion of pig (9 %) would be atypical for a deposit associated with altar activity, whereas pig bones regularly occur in consumption debris³⁴. The faunal remains from area P 16 consequently elude clear classification as either altar or consumption debris. By contrast, the animal bones recovered from the area of the ash altar in the sanctuary of Zeus at Mt. Lykaion (Arcadia/GR) are for the most part made up of heavily burned and fragmented femura, patellae, and caudal vertebrae of sheep and goats³⁵. Thus, the extremity bones and tails of the animals were burned on the altar, while the remaining parts of the animals were presumably prepared and eaten. Radiocarbon dating of selected calcined animal bone fragments suggests that this

sacrificial practice continued essentially unchanged from the Mycenaean period into the Early Iron Age. Based on the altar debris from Mt. Lykaion, regular *thysia* sacrifices can be assumed from an early stage of the cult of Zeus, suggesting that, despite the inconclusive nature of the osteological evidence, sacrificial meat was also consumed at Olympia, presumably right from the beginning of the cult.

The presence of numerous iron and bronze tripod kettles at Olympia³⁶ lends further support to the above-mentioned idea that the meat of the sacrificial animals was boiled. In the Mycenaean period, tripod cauldrons seem to have been used for the boiling of meat³⁷, and this practice likely persisted into the Early Iron Age³⁸. The gruesome myth of the rejuvenation of Pelias, involving the boiling first of a ram and then of the dismembered king in a tripod kettle, may actually reflect the cooking of sacrificial meat in a metal cauldron³⁹. The latter is illustrated by the shoulder frieze of the Ricci Hydria, where a large cauldron standing over the fire appears in the context of an animal sacrifice⁴⁰. Generally, the boiling of sacrificial meat was much more common and widespread than is suggested by the few textual references⁴¹.

During the early excavations at Olympia, fragments of iron tripod cauldrons were found in the lower of the two black layers extending around the early ash altar of Zeus⁴². According to the chronology established by Michael Maaß, the dedications of bronze tripod cauldrons started at Olympia in the early 9th century BCE⁴³. More recently, however,

³¹ Kyrieleis 2006, 16–17.

³² Kyrieleis 2006, 43–44; Benecke 2006a, 248.

³³ For the difference between bone assemblages deriving from sacrificial activity at the altar and consumption debris, the leftovers of meals eaten by the worshippers, see Ekroth 2009, 136–142.

³⁴ Ekroth 2009, 137, 140; 2017a, 27, 42.

³⁵ Romano/Voyatzis 2014, 614–615; B. M. Starkovich in: Romano/Voyatzis 2014, 644–648; Romano/Voyatzis 2021, 4. Pig and cattle only occur in very small amounts.

³⁶ Maaß 1978.

³⁷ Sherratt 2004, 313–314, 332–333; Wright 2004b, 158, 160–161, 169; Eder 2015, 118, 121–122.

³⁸ For the boiling of pork meat (or rendering of pig fat) in a cauldron (ἀβης), presumably set on a tripod stand, see Hom. Il. 21, 362–364. Cf. Bruns 1970, 38; Sherratt 2004, 306 note 14; Boterf 2017, 214–215. A tripod filled with soup (ἔρως) is mentioned by Alcman fr. 17. For full discussion of this fragment, see Boterf 2017.

³⁹ Halm-Tisserant 1993, 28–33, 38–43. For other myths involving the boiling of human meat, see Ekroth 2008, 98–100. Cf. Ekroth 2019, 243.

⁴⁰ Durand 1989, 102 fig. 2 (the cauldron is, however, not set on a tripod, as Durand assumes, but rests on ceramic supports called *lasana*); Gebauer 2002, 325 fig. 201.

⁴¹ See e. g. Burkert 1983, 89–90 note 29; Kron 1992, 646–647; Ekroth 2007, 266–268; 2017a, 21, 45–46; 2019, 242–243. One of the earliest literary references to the boiling of sacrificial meat in (metal) cauldrons (ἀβητες) is incidentally concerned with Olympia: Hdt. 1, 59, 1.

⁴² Furtwängler 1890, 3: »[...] in der tiefsten Schicht; hier auch Teile größerer einfacher Dreifüße von Eisen, während Fragmente kunstreicherer Dreifüße von Bronze nur in der oberen, [...] Schicht vorkamen.« On the iron tripods, see Maaß 1978, 126–130. Kyrieleis (2006, 97–98 note 410) provides a list of (Proto)geometric tripod fragments from the black layers in the north-western section of the Altis.

⁴³ Maaß 1978, 105–112.

Moritz Kiderlen has convincingly dated the earliest bronze tripod cauldrons found at Olympia to the end of the 11th century BCE at the latest⁴⁴. If this is correct, tripod cauldrons were already employed in the sanctuary, probably to boil sacrificial meat, in the early phase of the cult. The tripods are usually assumed to have been dedicated after being used, not only to commemorate the animal sacrifice but also as a tangible token of the dedicant's social status as a member of the elite⁴⁵.

Susan Sherratt's argument that roasting on spits (*obeloi*) became the standard method of cooking the innards and meat of sacrificial animals from as early as c. 1000 BCE is not readily confirmed by the ar-

chaeological record at Olympia⁴⁶. The majority of the numerous iron spits was found under the northern embankment of the Stadium and in the southeast area of the sanctuary, many of them in wells⁴⁷. The first wells at Olympia were dug in the early 7th century BCE⁴⁸. The earliest well containing a spit can be dated to the first half of the 7th century BCE⁴⁹. On the other hand, the black strata around the prehistoric tumulus seem not to have produced any significant number of spits⁵⁰. This is consistent with the general picture of a comparatively late appearance of iron *obeloi* in the Peloponnese, first in Late Geometric tombs at Argos and subsequently, from the early 7th century BCE onward, in sanctuaries⁵¹.

Early Dedicatory Practice at the Altar of Zeus

Aside from the early bronze tripod cauldrons, only a few metal offerings at Olympia can be securely dated to the Submycenaean or Protogeometric periods; they include some bronze dress pins and fibulae⁵². Other pieces of bronze jewellery, for instance some of the plain bracelets, may also date to the Protogeometric period⁵³. While the number of dress pins at Olympia slowly increased until the early 7th century BCE, the majority of the datable pins – about 175 of nearly 250 pre-Byzantine specimens – were dedicated during the Archaic period⁵⁴. Much the same holds true for the pre-Roman fibulae, though the dedications reached their peak a little earlier, with approximately 100 out of 170 specimens⁵⁵, in the period between 750 and 650 BCE. At least some of these dress ornaments may have been dedicated together with garments⁵⁶.

Of particular interest is another category of personal ornaments – bronze sheets with punched decoration⁵⁷. Even though about half of the approximately 350 preserved sheet bronzes were found in the black strata in the north-western Altis, they have received little attention in the context of the early history of the cult. Most of these bronze sheets were decorated with geometric motifs consisting of punched dots applied from the reverse side. They served mainly as dress ornaments or items of jewellery, such as headbands, bracelets, and belts. Just over 100 of these bronze sheets were carefully folded, some more than ten times, prior to their deposition. Susanne Bocher has argued that this practice was clearly intentional, probably to emphasize the dedication of the objects to a deity and/or to prevent further use⁵⁸. In her recent publication of the sheet

⁴⁴ Kiderlen 2010, esp. 93. 98–102; Kiderlen et al. 2016, 304–305; Bode et al. 2020, 331. Cf. Eder 2015, 120–121; 2024.

⁴⁵ Morgan 1990, 43–47. 192; de Polignac 1996; Kilian-Dirlmeier 2002, 216. 220.

⁴⁶ Sherratt 2004, 312–313. 332–333.

⁴⁷ Baitinger/Völling 2007, 66.

⁴⁸ Mallwitz 1988, 98; 1999, 197.

⁴⁹ Baitinger/Völling 2007, 68. 76 no. 234 pl. 18.

⁵⁰ Furtwängler (1890, 170 no. 1097 with fig.) published only a single specimen misinterpreting it as a sword. But cf. Kyrieleis (2006, 16), who mentions fragments of iron spits from the black layers in the Pelopion area.

⁵¹ Baitinger/Völling 2007, 74–75.

⁵² Philipp 1981, 36 nos 1–6 pls 1. 26 (pins); 261–263 nos 984–987 pls 18. 59 (fibulae).

⁵³ Philipp 1981, 197 with note 392; 198–199 nos 721–730 pls 12. 45.

⁵⁴ Völling 2002, 99 fig. 9.

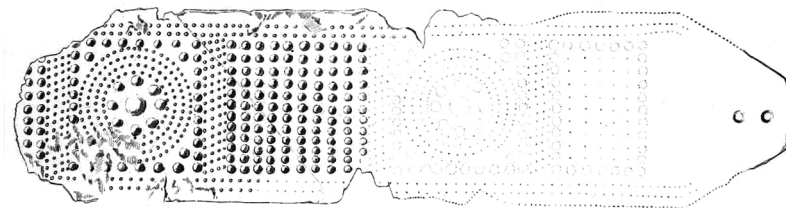
⁵⁵ Völling 2002, 99–100 fig. 10.

⁵⁶ Philipp 1981, 21–22; Bocher 2013, 360. Pausanias (5, 16, 2. 6) mentions that a peplos woven by the Sixteen Women of Elis was dedicated to Hera at Olympia. Cf. Pilz 2020c, 106–110.

⁵⁷ Bocher 2006/2007; 2013, 360–361; 2015, 54–55; 2018.

⁵⁸ Bocher 2018, 210–214.

Fig. 2 Bronze sheet with punched decoration from Olympia. Protoegeometric? Athens, National Archaeological Museum 6401. – (After Furtwängler 1890, pl. 19 no. 318). – L. 19.3 cm.



bronzes with punched decoration from Olympia, Bocher suggested that some of them may have been dedicated in the Protoegeometric period⁵⁹. In fact, several bronze sheets from Olympia (**fig. 2**) show conspicuous similarities to specimens from burial contexts in central and northern Greece dated to the 11th and 10th centuries BCE⁶⁰. Bocher has also mentioned the possibility that some of the bronze sheets with punched decoration were dedicated by visitors from central and northern Greece⁶¹. If so, this would shed new light on the question of whether or not Olympia was already an inter-regional centre in the Protoegeometric period.

Overall, it can be stated that relatively few metal objects were dedicated at Olympia during the Protoegeometric period. Likewise, early terracotta offerings seem to be confined to a relatively small number of hand-made bovine, horse, and human figurines⁶². On stylistic grounds, Wolf-Dieter Heilmeyer assigned the earliest zoomorphic clay figurines to the 10th century BCE⁶³. His chronology has been much disputed⁶⁴, but several new finds indicate that the production of hand-made animal figurines may have continued from the Late Bronze into the Early Iron Age⁶⁵. If this is the case, the earliest terracotta animal figurines found at Olympia could actually date to the later 11th century BCE. The interpretation of the clay figurines will be discussed below in connection with their bronze counterparts.

According to Kiderlen's revised chronology of early bronze tripod cauldrons⁶⁶, these expensive and prestigious metal vessels would have been dedicated from the initial phase of the cult onward. This, in turn, would allow a further interpretation of the sanctuary's social function as a meeting place during the early phase of its existence. Due to their considerable material value, tripod cauldrons have repeatedly been interpreted as offerings by members of elite groups⁶⁷. This is not inconsistent with the notion that tripod cauldrons were used to boil meat of the sacrificial animals. Indeed, Azzurra Scarci and Gerhard Stawinoga have observed that several tripod legs were exposed to fire⁶⁸. The tripod kettles were probably used as cooking pots during sacrificial banquets sponsored by members of the elite and subsequently dedicated in commemoration of the feast. Oversized bronze tripod cauldrons reaching heights up to 3.50 m and clearly unsuitable for any practical use seem to appear only at a much later stage, during the 8th century BCE⁶⁹. Only at that point did competitive dedications of bronze tripod cauldrons supplant these vessels' original function in the ritual context, the boiling of sacrificial meat⁷⁰. Much of the symbolic meaning of tripod cauldrons throughout the Early Iron Age derives from their close association with the Mycenaean past⁷¹. This is likewise true for the Protoegeometric *kylikes*, several fragments of which have been found at Olympia. Except for the

⁵⁹ Bocher 2018, 189. 216.

⁶⁰ E. g. Furtwängler 1890, 48 no. 318 pl. 19; Bocher 2018, 54. 103. 113–114. 297 no. 265.

⁶¹ Bocher 2006/2007, 90; 2015, 55; 2018, 207–208.

⁶² E. g. Heilmeyer 1972, 97 nos 3–5 pl. 2 (bovids); 101 no. 53 pl. 10 (horse); 113 no. 174 pl. 28 (male figurine); Kyrieleis 2006, 86. 103 nos 3–6 pls 11–12 (bovids); 106 nos 36–38 pls 16–17 (horses); 116 no. 114 pl. 28 (male figurine).

⁶³ Heilmeyer 1972, 10–12. 20. 89.

⁶⁴ For brief summaries of the discussion, see Eder 2001, 201–202; Kyrieleis 2006, 84–85.

⁶⁵ Eder forthcoming.

⁶⁶ See note 44.

⁶⁷ See note 45.

⁶⁸ Scarci/Stawinoga, this volume.

⁶⁹ For a discussion of the phenomenon, see Maaß 1978, 73–77; Kyrieleis 1996, 102–103; Völling 2002, 93; Junker 2020, 383–384.

⁷⁰ Cf. Maaß 1978, 4: »Die Unterscheidung zwischen dem geweihten Gebrauchsgegenstand und dem ausschließlich für die Weihung gearbeiteten Gerät ist nicht sicher zu treffen. Eindeutig gehören die hohen, unbeweglichen spätgeometrischen Dreifußkolosse [...] zu den letzteren.«

⁷¹ Papalexandrou 2005, 9–63; Eder 2015.

ribbed stems, the shape of the Early Iron Age *kylikes* closely resembles that of their Late and Submycenaean counterparts. Birgitta Eder has convincingly argued that the vessel shape may have survived into the Protogeometric period because of its symbolic significance in the context of ritualized drinking⁷². This interpretation has now been confirmed by new finds from the sanctuary of Zeus at Mt. Lykaion, where the *kylix* was the most common type of vessel in the Mycenaean period and continued into the Early Iron Age⁷³.

Based on their style, the earliest bronze animal figurines have been assigned to the beginning of the 9th century BCE⁷⁴. The bronze zoomorphic figurines almost exclusively show bovids and horses in an approximate 1:1 ratio⁷⁵. Since only little more than half of the bovine figurines and 25 % of the horses feature male genitals, it is unlikely that only male animals are represented⁷⁶. During the 8th century BCE, the dedications of animal figurines increased exponentially, reaching a peak in the Late Geometric period⁷⁷. In the subsequent Early Archaic period, the numbers of terracotta and bronze animal figurines rapidly decreased.

Curiously outnumbering the approximately 500 individual clay animals⁷⁸ are over 4,200 preserved bronze zoomorphic figurines⁷⁹. The dedication of terracotta and bronze figurines representing domesticated animals almost certainly reflects concerns about animal husbandry⁸⁰. Although the average length of the Geometric bronze animals varies between only 4 and 6 cm, their material value was certainly not insignificant⁸¹. Since cattle and horse breeding were practiced mainly by the landowning

elite, most of the numerous bronze bovine and horse figurines can be assumed to have been dedicated by members of this social class⁸². The virtual absence of small herd animals such as sheep and goats from the finds of bronze animal figurines at Olympia lends indirect support to this idea.

In addition to single horse figurines, so-called chariot models – two-wheeled carriages drawn by horses and guided by a charioteer – were dedicated at Olympia⁸³. The earliest of the nearly 600 terracotta chariot models can be dated to the decades around 900 BCE⁸⁴. They outnumber sixfold the bronze chariot models that started roughly 100 years later, in the early 8th century BCE⁸⁵. After the end of the Geometric period, the dedications of chariot models decreased significantly. Even though chariots were no longer used for fighting in the Early Iron Age, they remained an important symbol of elite status⁸⁶. This stems also from the close association of two-wheeled chariots with the glorious past of the Mycenaean Age, readily apparent in the Homeric epics⁸⁷. Therefore, chariot models do not merely reflect elite behaviour, but also refer to a core ideological narrative of the Early Greek elite. The same holds true, as we have already seen, for the bronze tripod cauldrons⁸⁸, which continued to be dedicated in steadily growing numbers during the 9th and 8th centuries BCE. The oversized tripods of the Late Geometric period almost certainly testify, as mentioned before, to intense competition among members of the elite⁸⁹.

In comparison to the thousands of (Proto)geometric animal figurines, clay and bronze figurines of humans remain conspicuously rare. Many of them belonged to chariot models, and a significant num-

72 Eder 2006, 206–210.

73 Romano/Voyatzis 2021, 4. 16 and note 52 figs 10. 16f.

74 Heilmeyer 1979, 55. 57.

75 Heilmeyer 1979, 196. 275 tab. a. For additional bronze animal figurines from more recent excavations, see Kyrieleis 2003, 110–126 nos 1–24 figs 65–100; Kyrieleis 2006, 119–130 nos 1–130 pls 34–49; Herrmann/Moustaka 2013, 122–123 nos 1–7 figs 15–16.

76 Bocher 2013, 359 fig. 6.

77 Völling 2002, 91–93.

78 Heilmeyer 1972, 123 tab. a, reports 205 bovids, 197 horses and 141 fragments of horse figurines (most of which belonged to chariot models, see below) as well as 84 rams. Kyrieleis (2006, 102–110 nos 1–72 figs 2–5 pls 11–23) presents additional clay animal figurines from the Pelopion excavation.

79 See note 75.

80 Heilmeyer 1972, 54. 87–88; Schürmann 1996, 218–219; Himmelmann 2002, 94–95.

81 Bocher 2013, 359 (average weight between 40 and 70 g). Cf. Schürmann 1996, 219 with note 663.

82 Schürmann 1996, 219–220.

83 Heilmeyer 1972; 1994.

84 Heilmeyer 1972, 20–21. 41–42.

85 Völling 2002, 91.

86 Crouwel 1992, 102. 104–106; Muhly 2008, 150–153.

87 Crouwel 2006, 165–168; Eder forthcoming.

88 See note 71.

89 See note 69.

ber of anthropomorphic bronze statuettes originally adorned tripod cauldrons. The remaining individual human figurines, numbering roughly 100, with most dating to the Late Geometric period, are predominantly male and usually naked⁹⁰. Several wear helmets or helmet-like caps, indicating their role as warriors. Eder has recently argued for continuity in the production of hand-made male terracotta figurines from the Late Bronze into the Early Iron Age⁹¹. Some of the figurines from Olympia have raised arms, explained as a gesture of epiphany. This is, however, not the place to enter the debate over the interpretation of these figurines as images of Zeus or human dedicants⁹².

Heilmeyer has associated the 16 naked female terracotta and bronze figurines with (the cult of) Hera⁹³. The discussion has been continued by Kyrieleis, who rejected Heilmeyer's view and suggested that female figurines, as with animals and chariot models, were reflections of male elite life⁹⁴. Although this approach is reasonable, we should also bear in mind that, from the Early Archaic period onward, the depiction of naked female terracotta figurines seems closely linked to cults of female divinities⁹⁵.

A further category of dedications can be discussed here only very briefly. Starting around 800 BCE, the deposition of weapons and armour slowly increased

until the end of the 8th century BCE. During the Archaic period, they became much more commonplace, peaking at the end of the 6th century BCE⁹⁶.

In conclusion, the majority of the early dedications associated with the altar of Zeus (tripod cauldrons, chariot models, animal figurines, weapons) can be intimately linked with the male elite sphere. These objects can therefore be assumed to have been dedicated by predominantly male worshippers. The presence of female dedicants is, on the other hand, likely in view of the items of jewellery and dress ornaments deposited in the Altis⁹⁷. While fibulae and dress pins occasionally occur in warrior graves, jewellery, with the exception of finger rings, is usually absent from Early Iron Age male burials⁹⁸. A good case in point concerns the above-mentioned headbands with punched decoration, which appear to be found only in female graves⁹⁹. Even though Zeus is now commonly assumed to have been the main deity of Olympia right from the beginning of cult activity¹⁰⁰, the possibility that some of the dress accessories and pieces of jewellery from the black layers in the north-western Altis were dedicated to one or more female divinities cannot be excluded¹⁰¹. The same applies to the admittedly few female clay and bronze figurines.

⁹⁰ For the terracotta figurines, see Heilmeyer 1972, 112–116 nos 163–208 pls 26–35; Kyrieleis 2006, 114 no. 104 pl. 28, 3–4; 115–118 nos 113–131 pls 28–32. The early human bronze figurines have not yet been studied comprehensively. Heilmeyer (1994, 206–207 nos 1–40) provides a useful list, to which a male figurine found in the Pelopion area can be added: Kyrieleis 2006, 131 no. 132 pl. 49, 6–8.

⁹¹ Eder forthcoming.

⁹² Murray (2022, 73) has recently summarized the discussion. See also Kyrieleis 2006, 87 note 358.

⁹³ Clay figurines: Heilmeyer 1972, 61. 77–78. 116 nos 205–208 pl. 35; Kyrieleis 2006, 118 no. 132 pl. 32, 5. Bronze figurines: Heilmeyer 1994, 206–207 nos 13–18. 39–40.

⁹⁴ Kyrieleis 2006, 87–88.

⁹⁵ Pilz 2011, 184–186; 2020b, 313.

⁹⁶ Graells i Fabregat/Schmid 2020, 13.

⁹⁷ Philipp 1981, 19; Kron 1996, 159; Kilian-Dirlmeier 2002, 221–222.

⁹⁸ Strömberg 1993, 90–93.

⁹⁹ Bocher 2018, 189. 207.

¹⁰⁰ Kyrieleis 2006, 41. 55. 61.

¹⁰¹ Philipp 1981, 21; Himmelmann 2002, 92; Barringer 2021, 21.

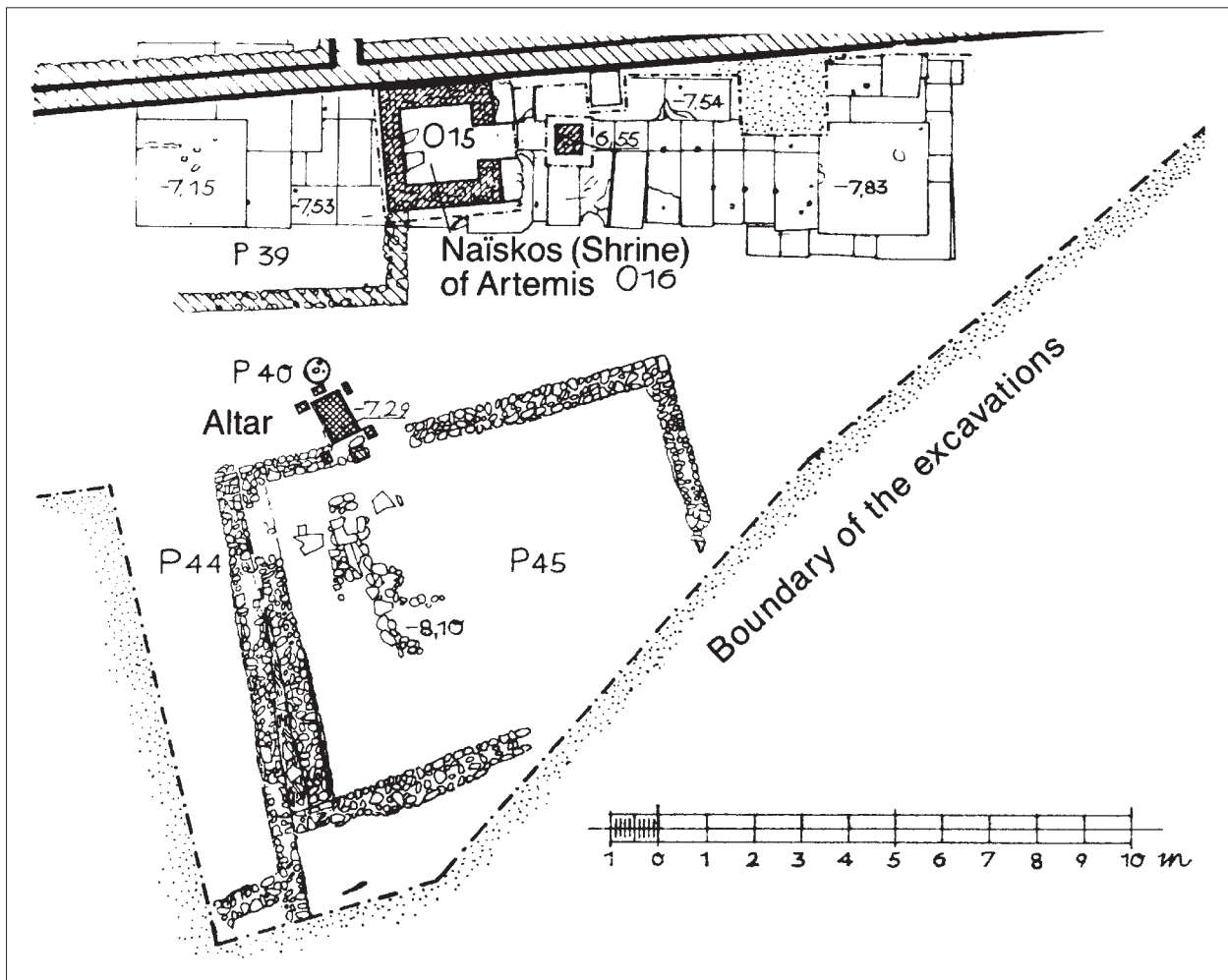


Fig. 3 Plan of the sanctuary of Artemis southeast of the Altis. – (Plan A. Mallwitz).

The Black Layer at the Altar of Artemis

The second substantial *schwarze Schicht* was detected outside the Altis in the south-eastern part of the sanctuary (see **fig. 1**) extending in the area of a Late Archaic altar that was in all likelihood dedicated to Artemis. In his enumeration of the altars on which the Eleans sacrificed during a monthly procession, Pausanias lists eight altars of this goddess¹⁰². One of these altars was situated on the way to the Hippodrome¹⁰³. This fits very well with the position of two

altars excavated in the area southeast of the Altis in the early 1960s (**fig. 3**)¹⁰⁴. The altar that Pausanias saw was not the Late Archaic altar, but that of the Roman Imperial period, situated around 5 m north-east of the former and adjacent to a small shrine¹⁰⁵. The Roman altar bears the painted inscription Ἀρτέμιδ[ος] on the plastered surface of its western side. The earlier altar was undoubtedly dedicated to Artemis as well. It can be dated to the late 6th or early

¹⁰² Paus. 5, 14, 5. 6; 5, 15, 4. 6. 7. 8.

¹⁰³ Paus. 5, 15, 6.

¹⁰⁴ Kunze 1963, 107–108; Mallwitz 1988, 92–93; Kyrieleis 1994, 8–16; Heiden 2013; forthcoming.

¹⁰⁵ Kyrieleis 1994, 8–11 figs 10–15. The altar shows the painted inscription Ἀρτέμιδ[ος] on the plastered surface of its western side.

5th century BCE and was probably in use until the 3rd century BCE¹⁰⁶.

In the area around the earlier altar, the excavators encountered a layer of blackened earth mixed with ashes, fragments of animal bones, and pottery as well as dedicatory material¹⁰⁷. In close proximity to the altar, the black layer or *Opferschicht* had accumulated *in situ*, almost reaching its upper edge¹⁰⁸. Prior to the construction of the altar, an ash altar of Artemis can be assumed in the absence of earlier built structures. The north-western and northern part of the black stratum was already investigated during the first systematic excavations, it appears¹⁰⁹.

In fact, as Joachim Heiden has recently demonstrated, the black layer extended, from the Late Archaic altar, some 20 m to the north and northwest (see **fig. 1**)¹¹⁰, in other words, into the area excavated in 1880/1881. According to Heiden's reconstruction, the black layer was as much as 1.40 m thick around the Late Archaic altar and thinned out the farther it went from the central area. This characterization makes clear that we are not dealing with displaced material originating from the Altis, but a genuine black layer resulting from prolonged sacrificial and dedicatory activity at the altar of Artemis.

Sacrificial Dining at the Altar of Artemis

Limited excavation carried out by Heiden in 2002 showed that the black layer continued underneath the altar, indicating that the earliest cult activity predated its construction in the Late Archaic period¹¹¹. During the short campaign, nearly 1,400 fragments of animal bones were collected from previously unexcavated portions of the black stratum and subsequently examined by Benecke. In contrast to the faunal remains from the Pelopion area, only a very few of the animal bone fragments from the Artemis altar show traces of burning or were calcined, while several carried hack and cut marks¹¹². Among the species identified, sheep and goats predominate (78.1 %), followed by cattle (17.5 %) and pigs (3.6 %). Benecke noted that thigh-bones and *patellae* were completely absent from the assemblage, while elements of the caudal spine are lacking or under-represented¹¹³. The absence of these parts, presumably

because they were burned on the altar as the portions offered to the deity, and the fact that the surviving bones are unburned strongly suggest they are consumption debris¹¹⁴. The general lack of traces of burning on the animal bones indicates that the sacrificial meat was boiled¹¹⁵, presumably in metal (tripod) cauldrons, several fragments of which have been found in the black layer around the older altar of Artemis¹¹⁶. In addition, the stratum yielded a considerable number of Laconian and Attic black- and red-figure drinking, pouring and mixing vessels¹¹⁷ suggesting the ritual consumption of wine, presumably during sacrificial meals. Notably, fragments of kraters seem to be absent from the Laconian and are under-represented in the black-figure pottery found in the area of the older Artemis altar¹¹⁸. This lends further support to the idea that the ubiquitous metal cauldrons (see below) were used as mixing bowls¹¹⁹.

106 Kunze 1963, 108; Mallwitz 1972, 200; Kyrieleis 1994, 16.

107 Bocher 2015, 56–57; Heiden forthcoming.

108 Kunze 1963, 107.

109 Furtwängler 1890, 6: »Gleich nordöstlich hinter dem Bau [i. e. the South East Building] und noch weiter nach Osten hin fanden sich in tiefschwarzer Schicht viele Gefäßhenkel, Kessel, Dreifußteile, Nagelbuckel, Waffen; auch alte Bronzeurkunden.«

110 Heiden forthcoming.

111 H. Kyrieleis in: Kyrieleis/Herrmann 2013, 6–7 figs 9–10.

112 Benecke 2006b; Bocher 2015, 57–58.

113 Benecke 2006b, 156.

114 Benecke 2006b, 159 (»leftovers of sacred meals«); Ekroth 2017a, 35. 43 note 125. 45; 2017b, 39. 44.

115 Cf. note 41.

116 See note 109; Heiden forthcoming.

117 Heiden forthcoming.

118 Heiden forthcoming. They occur more frequently among the still unpublished Attic and Elean red-figure pottery.

119 Cf. note 25.

Dedicatory Practice at the Altar of Artemis

The earliest finds from the black layer in the area of the older Artemis altar include Geometric bronze bovine and horse figurines, fragments of bronze tripod cauldrons, and a naked male bronze figurine wearing a helmet¹²⁰. One of the bronze animal figurines, a bovid, has been dated stylistically to the first half of the 9th century BCE¹²¹. Provided Kiderlen's revised chronology of the early bronze tripod cauldrons is correct¹²², several of the cast bronze tripod legs Heiden assigned to the black stratum at the altar of Artemis date to Protogeometric times, which could indicate an unexpectedly early date for the cult of Artemis at Olympia¹²³. A note of caution should be sounded here, however, since the reuse and distribution patterns of bronze tripod cauldrons in the sanctuary are not yet fully understood and currently under investigation¹²⁴. Most of the tripod cauldrons at Olympia have intentionally been dismantled soon after their dedication, most probably in preparation for re-melting the fragments¹²⁵. Even the heavy cast legs of the early tripod cauldrons were cut into pieces¹²⁶. Especially in the case of the bronze tripods with cast legs, though, single pieces of the disassembled kettles seem to have been redeposited, presumably in a *pars pro toto* fashion, not only at the ash altars of Zeus but also at the Artemis altar¹²⁷. In connection with the fragments of bronze tripod cauldrons associated with the black layer at the altar of Artemis, we may note that one fragment of a ring handle fits perfectly into a fragment which was found north of the Temple of Zeus¹²⁸. Likewise, two fragments of hammered tripod legs from the area of the Artemis altar belong to fragmented cauldrons



Fig. 4 Cast bronze miniature tripod from the black layer at the altar of Artemis. Geometric. Olympia, Archaeological Museum B 5395. – (Photo S. Bocher). – H. 3.9 cm.

that were found in other parts of the sanctuary¹²⁹. This is in line with the generally wider distribution of fragments of tripod cauldrons with hammered legs at Olympia, which indicates a reuse pattern different from that of the cauldrons with cast legs¹³⁰. Be that as it may, dedications of bronze tripod kettles were made in other early cults of Artemis in the Peloponnese. The sanctuary of Artemis Aontia at Ano Mazaraki in Achaia yielded a miniature tripod and at least three leg fragments of normal-sized tripods¹³¹. Miniature tripods are also present at the altar of Artemis at Olympia (**fig. 4**)¹³², increasing the likelihood that Artemis received dedications of normal-sized tripod cauldrons at Olympia as well.

Metal dedications of the Archaic and Classical periods consist of bronze vessels, including rod tripods and protome cauldrons, weapons and numerous

¹²⁰ Heiden forthcoming.

¹²¹ Heilmeyer 1979, 57. 71. 204 no. 83 pl. 14.

¹²² See note 44.

¹²³ Patay-Horváth (2015; 2020) suggested for other reasons that Artemis was initially the main deity of Olympia and was superseded by Zeus and Hera no earlier than 600 BCE. However, the existence of two early cult foci – one located immediately north of the prehistoric tumulus and presumably pertinent to Zeus, the other, associated with Artemis and outside the Altis in the south-eastern area of the sanctuary – is hard to reconcile with Patay-Horváth's hypothesis.

¹²⁴ Kyrieleis 2006, 97–98; Bocher 2013, 357–358; 2015, 53–54; Baitinger 2021; Scarci 2023; Scarci/Stawinoga, this volume.

¹²⁵ Metal workshops at Olympia: Baitinger/Völling 2007, 207–212.

¹²⁶ Bocher 2013, 357.

¹²⁷ Kyrieleis 2006, 98; Bocher 2015, 54. For tripod fragments found in the black layers at the Pelopion, see note 42.

¹²⁸ Maaß 1978, 158–159 no. 111c.

¹²⁹ Maaß 1978, 182–183 no. 207b; 183–184 no. 210i.

¹³⁰ Bocher 2013, 358.

¹³¹ Petropoulos 2019, 325. 338–339 figs 4. 71–73.

¹³² Maaß 1978, 213 no. 330; 215 no. 350; 223 no. 414 pl. 62; 225 no. 426 pl. 62; Heiden forthcoming. On unpublished bronze miniature tripods from the sanctuary of Artemis Limantis at Kombothekra (Triphylia/GR), see Sinn 1981, 64.

items of jewellery, especially snake-headed bracelets¹³³. Except for the jewellery, the above-mentioned Geometric and Archaic offerings from the Artemis altar share male elite connotations, as do most classes of the dedicatory material associated with the cult of Zeus inside the Altis. But from around 500 BCE, this picture changed, as increasing numbers of terracotta figurines and black-figured *lekythoi* were dedicated. In addition to a few representations of Artemis, the terracotta offerings include numerous female heads and protomes as well

as standing and seated female figures of the 5th and 4th centuries BCE¹³⁴. The figurines and protomes are likely to reflect concerns for critical stages of the female life cycle, such as the onset of puberty and the transition to adulthood, marriage, and childbirth¹³⁵. They can thus be assumed to have been dedicated by predominantly female worshippers. The same may be true for the *lekythoi*, which were presumably filled with perfumed oil¹³⁶. Unlike the terracotta offerings, the dedications of *lekythoi* remain limited to the first decades of the 5th century BCE.

Conclusion

In the sanctuary of Olympia, two distinct black layers have been detected: one concentrated in the area between the prehistoric tumulus and the later Heraion and another, less extensive, in the area of the Artemis altar southeast of the Altis (fig. 1). The *schwarze Schicht(en)* in the north-western Altis started to accumulate shortly before the mid-11th century BCE. The earliest dedications at the possible ash altar of Artemis may date to the Protogeometric period. Further research will be needed to clarify the precise chronology of the initial phase of the cult, but it is already becoming clear that the Artemis cult at Olympia had major significance from an early date.

As a result of the spatial reorganization of the sanctuary in the decades around 600 BCE, the formation process of the black layer in the north-western Altis came to an end. By contrast, ritual debris and offerings continued to accumulate at the cult place of Artemis to the southeast of the Altis even after the construction of a stone altar around 500 BCE. In fact, when the area was excavated, the black layer almost reached to the top of the altar. The latest finds from the stratum date to the 3rd century BCE.

Whereas the faunal remains from the *Opfer-schicht* at the Artemis altar clearly represent the leftovers of sacrificial meals, the limited osteological material recovered from the black strata in the Pelopion area cannot easily be classified as either altar or consumption debris. The faunal evidence from Mt. Lykaion, however, indicates that Zeus received regular *thysiai* there in the Early Iron Age; the same is likely to be the case at Olympia. Presumably, the sacrificial meat was prepared for human consumption by boiling it in metal tripod cauldrons. No clear evidence for the roasting of meat on iron spits (*obeloi*) exists prior to the Late Geometric period. Among the Early Iron Age pottery from the Pelopion excavation small open vessels predominate, indicating the ritual drinking of wine, which probably took place in the context of sacrificial feasting. Dedicated after their presumed use as cooking pots, the tripod cauldrons represent tangible remains of these feasts sponsored by members of the elite. Based on Kiderlen's revised chronology, offerings of bronze tripod cauldrons can now be traced back to the initial phase of the Zeus cult at Olympia. Not until the appearance

¹³³ Heiden forthcoming. For the bracelets, see Philipp 1981, 22. 24. 222.

¹³⁴ Kunze 1963, 108 pl. 144a. c; Daux 1963, 788 figs 2-3; Kyrieleis 1994, 16 figs 19-21; Himmelmann 2002, 91-92 figs 1-4; J. Heiden in: Heilmeyer et al. 2012, 414-416 nos 4/3-13. 4/15-16 with figures; Heiden 2013, 369 fig. 5. For full publication of the terracottas, see Heiden forthcoming.

¹³⁵ Cf. Huysecom-Haxhi/Muller 2015, 428-434.

¹³⁶ Alexandridou 2011, 28.

of oversized tripods in the 8th century BCE does the device become detached from its practical function. No pottery of Protogeometric, Geometric or Early Archaic date from the black stratum at the Artemis altar has been published as yet. From the 6th century BCE onward, the presence of Laconian and Attic black- and red-figure drinking, pouring and mixing vessels points to wine consumption, most probably in connection with the sacrificial dining firmly attested here.

Strikingly, the dedicatory material of the Geometric and Archaic periods found in the area of the Artemis altar is indeed very similar to that associated with the cult of Zeus in the Altis. At both cult foci, offerings included iron and bronze tripod cauldrons, bronze vessels, weapons, clay and bronze animal and human figurines, and jewellery. The

dedicatory practice at the altar of Artemis, it would seem, differed only slightly from that of the Zeus cult until the Late Archaic period, implying that the constituencies of both cults must have been rather similar. In fact, most of the above-mentioned classes of offerings are closely associated with the male elite sphere. Only after about 500 BCE, when numerous terracotta figurines and protomes as well as *lekythoi* appear, does the spectrum of offerings in the cult of Artemis change significantly as female worshippers likely gain more prominence. As I have shown elsewhere, a similar phenomenon can be observed at a somewhat earlier date in the sanctuary of Artemis Limnatis at Kombothekra in Triphylia¹³⁷, where dedicatory practice seems to reflect a shift from a male sub-elite to a predominantly female constituency from the late 7th century BCE onwards.

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¹³⁷ Pilz 2020a, 338–346. 352–354.

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»Die Zerstörung der älteren Bronzeweihgeschenke und die Zersplitterung der Fragmente hat schon in recht früher Zeit begonnen«

Fragmented Bronze Objects in Greek Sanctuaries and in European Scrap Hoards

ABSTRACT

The practice of fragmenting bronze (and later iron) objects is a common phenomenon in large parts of Europe, especially in the Late Bronze Age. Researchers have frequently and intensively discussed the so-called scrap hoards which contained many deliberately damaged bronzes and their meaning, whereby a sacral interpretation of the phenomenon has recently been strongly advocated, at least in German-speaking research. Against this background, it seems valuable to include fragmented votive offerings from Greece in the discussion, as they provide important insights from a region that has produced only few hoards but large stocks of intentionally fragmented bronze objects from important sanctuaries like Olympia, Delphi or Kalapodi. Their systematic analysis – also with the help of methods developed for Bronze Age scrap hoards – promises important results for the practice and interpretation of fragmentation, which was widespread in Europe at certain times.

KEYWORDS

Olympia | Greek sanctuaries | Bronze Age | metal objects | votive offerings | scrap hoards | fragmentation | cultural practice

Fragmented objects are part of the everyday life of an archaeologist. Unless one has the good fortune to excavate princely tombs or outstanding deposits, one often has to deal only with incompletely preserved objects or tiny fragments which often cannot be identified and correctly addressed straight away. This holds especially true for objects made of bronze or iron, because strong corrosion or failure to restore the pieces make a correct classification and dating difficult or even impossible to achieve. On the other

hand, such fragmentarily preserved objects have a special appeal. Classifying them in terms of cultural history and evaluating them in their context at a specific site is a challenge, because further information often has to be painstakingly extracted from these objects. But the understanding of fragmentation as part of the »biography« of an object and as a cultural practice can open up new ways of interpreting such pieces.

Fragmentation in Supra-Regional Context

The phenomenon of fragmented objects has been a recurring topic in archaeological and historical research, but in different regions and in various periods in different ways and with divergent methods, perspectives and interpretations, often produced using different data sets¹. Therefore, it is necessary not only to bring together these different approaches but also to introduce material from areas which have not yet been the focus of fragmentation studies. One such region is Greece, with its important sanctuaries that have often attracted visitors from all parts of Greece or even from other regions of the Mediterranean world. Some of these sacral places have produced thousands upon thousands of bronze and iron objects, most of which were dedicated to the gods as votive offerings in the first half of the first millennium BC and most of which are preserved only in a more or less fragmentary state. A considerable number of them show traces of deliberate damage, as is also known from numerous pieces in European Bronze Age scrap hoards².

In Central Europe, hoards with bronze scrap (that means fragmented finished objects) in combination with copper ingots (that means raw metal) already appear at the transition from the Early to the Middle Bronze Age. Typical for this period in Southern Germany are the hoards from Bühl im Ries (community of Alerheim, Lkr. Donau-Ries/DE) and Ackenbach (community of Deggenhausertal, Bodenseekreis/DE) which both contain mainly broken sickles, axes and weapons³. It is most probably no coincidence that the still quite isolated occurrence of scrap hoards in Central Europe coincides with the appearance of copper-tin alloys, viz., bronze in the

true sense of the word. Especially in the Late Bronze Age, such hoards of different size and composition are a very common phenomenon in large parts of Europe, albeit with temporal shifts between different regions⁴. Especially from the 13th century BC (Reinecke Bz D) onwards, scrap hoards became extremely numerous in various regions of Europe, as a schematic map drawn by Alix and Bernhard Hänsel shows very clearly (**fig. 1**)⁵. In addition to complete objects and parts of copper ingots (*Gusskuchen*), such scrap hoards contain bronze fragments on a large scale, which can only rarely be re-fitted. The fragments show often traces of deliberate damage, e. g. chiselling marks or bending. Hence, they have usually not been broken by a long and intensive use of the object or due to a casting defect, but have been intentionally demolished or crushed at an initially unspecified point in time. The maximum size of the fragments frequently corresponds to the diameter of the melting crucibles⁶. Large objects were regularly demolished, while smaller ones often remained undamaged. At the transition from the Late Bronze Age to the Early Iron Age, such scrap hoards and also river finds disappear almost abruptly from the archaeological record in large parts of Europe, apart from a few areas like Italy⁷ or the Alpine region⁸, where scrap hoards still occur in the Iron Age, while in other regions – such as Brittany – only hoards with socketed axes of a very poor casting quality survive into the Early Iron Age⁹.

A typical representative of a Late Bronze Age scrap hoard from Slavonski Brod on the River Sava in eastern Croatia (Brod-Posavina County/HR), is stored in the collection of the LEIZA in Mainz and

¹ The number of publications on this topic is almost endless and a detailed bibliography would vary depending on the perspective and academic socialisation of the author. See recently e. g. Chapman/Gaydarska 2007; Brandherm 2018; Renfrew et al. 2018; Fontijn 2020; Knight 2022; Sörman et al. 2024. – The proceedings of the international conference »Pezzi scelti. Distruzione e manipolazione di beni tra età del Bronzo e del Ferro: dal riciclo al sacrificio / Choice Pieces. The Destruction and Manipulation of Goods in the Later Bronze Age: from Reuse to Sacrifice (Rome, 16–18 February 2012)« have unfortunately never been published.

² Baitinger 2021.

³ Dehn 1952; Kimmig 1955; Rittershofer 1983.

⁴ E. g. Sprockhoff 1937; 1956; von Brunn 1968; Geißlinger 1984; Hansen 1994; Huth 1997; 2024.

⁵ Hänsel/Hänsel 1997, front endpaper.

⁶ E. g. Huth 2008, 138.

⁷ E. g. Albanese Procelli 1993; Giardino 1995. – The largest and most famous Iron Age hoard is the one from San Francesco di Bologna (Zannoni 1888).

⁸ Schindler 1998; Egg 2016.

⁹ Briard 1965, 242–282; Milcent 2017.

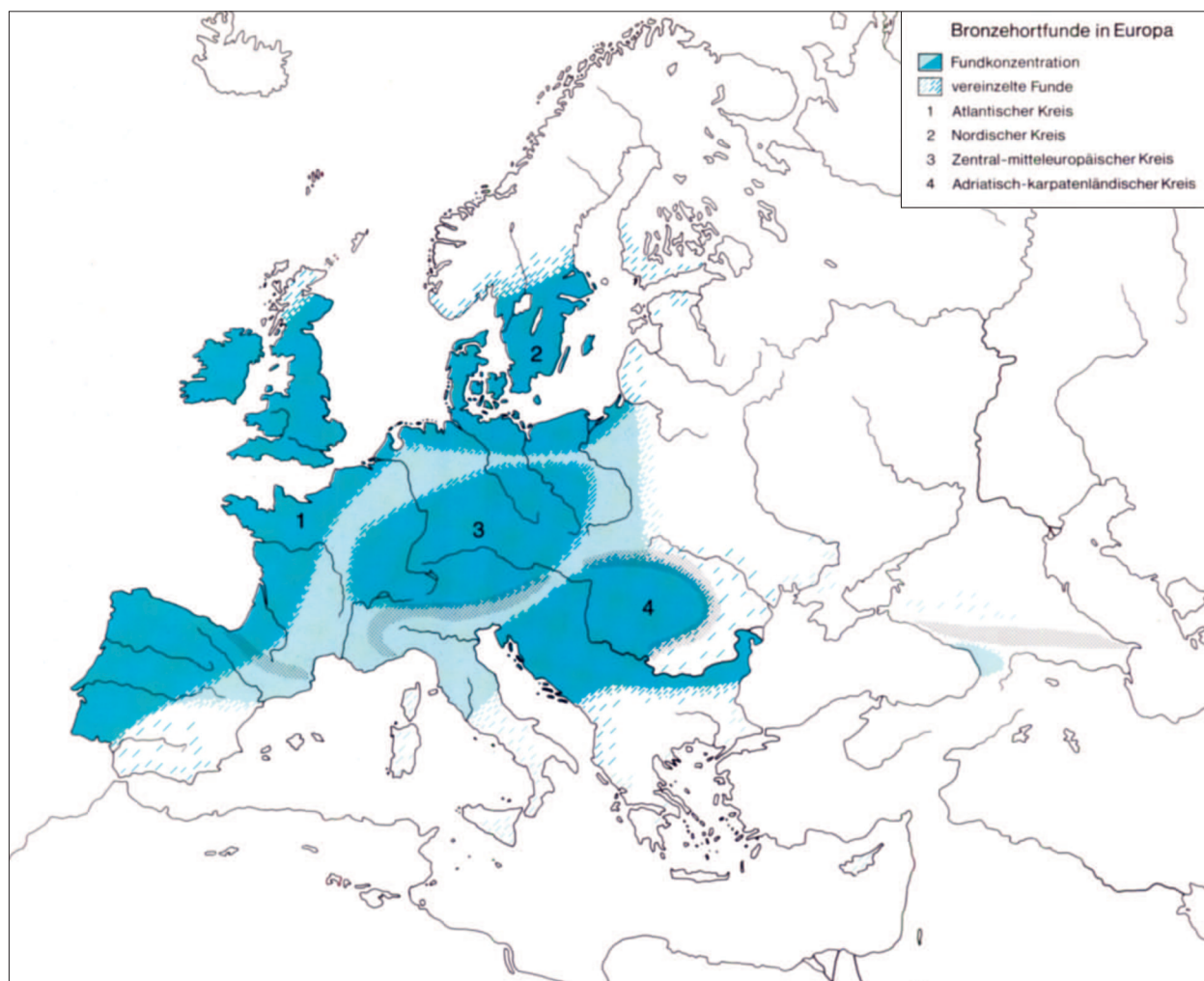


Fig. 1 Schematic distribution map of bronze hoards in Europe. – (After Hänsel/Hänsel 1997, front endpaper).

was published 20 years ago by Christoph Clausning (**fig. 2**)¹⁰. The complex dates to the 13th or 12nd century BC, at the transition from the Early to the Older Urnfield period (Reinecke Bz D/Ha A1). The find was interpreted by Clausning as a foundry hoard or the material stock of a bronze craftsman. The hoard contains above all parts of copper ingots, axes, arms and armour, sickles and jewellery. Most of these pieces are only fragmentarily preserved alongside occasional complete objects.

The interpretation of such hoards and their contents has long been the subject of intensive and controversial discussions. The different interpretative approaches oscillate back and forth between »foundry or merchant deposits« and »sacred deposits«¹¹. While older studies up to the 1980s distinguished between profane »custody finds« and sacred »consecration finds«, a paradigm shift took place in German research from the mid-1990s onwards. In the exhibition catalogue »Gaben an die Götter« (Gifts to

¹⁰ LEIZA Inv. O.40515_001 – O.40515_238: Clausning 2003.

¹¹ For the German research see e. g. Geißlinger 1984; Torbrügge 1985; Pauli 1985; Hansen 1994; Sommerfeld 1994; Clausning 2003; Huth 2008; Hansen 2016; Huth 2024.



Fig. 2 Bronze scrap hoard from Slavonski Brod in the collection of the LEIZA in Mainz. – (Photo S. Hölper, LEIZA).

the Gods), the Berlin prehistorian Bernhard Hänsel (1937–2017) interpreted all these bronze hoards as sacred depositions¹². With this universal interpretation, a source-critical examination of the individual complex and its context of discovery seemed not necessary any more. However, Hänsel's rejection of the examination of individual finds and his demand that explicit evidence be provided only for »profane« depositions is hardly tenable because »sacred« and »profane« often went hand in hand in prehistoric societies. In the same exhibition catalogue, Louis Nebelsick suspected an ecstatic sacrificial mode behind the destruction, which he compared to the Dionysian rites in the Greek world characterised by ecstasy and frenzy¹³.

In fact, the practise of fragmentation is still often treated at the regional level or along the same time line, which does not do justice to the diversity and frequency of the phenomenon in time and space. Nebelsick's interpretation approach almost

demands the use of finds from Greek sanctuaries for comparison with scrap hoards, even though Greece does not form part of the European »scrap hoard phenomenon« (fig. 1). The number of Late Bronze Age hoards in Greece is quite small, and these which are known rarely contain fragmented objects¹⁴. The famous hoard from Tiryns in the Argolis with golden objects and bronze vessels has been interpreted by Georg Karo (1872–1963) as the treasure of a tomb raider¹⁵. However, a recently published bronze hoard from Stephani (Preveza/GR) in Epirus contained broken double axes and spearheads¹⁶, but this find-spot is on the periphery of the Greek world in north-west Greece. For this reason, fragmented bronze objects from Greece were only rarely introduced in the discussion of the meaning of Late Bronze Age scrap hoards. In this context, one has to mention especially several important publications by Svend Hansen, who used material from Greek sanctuaries as a background foil for interpreting the hoards¹⁷.

¹² Hänsel 1997. – Critical evaluation by Eggert 2003, 428–439; 2012, 81 note 61.

¹³ Nebelsick 1997, esp. 40–41; 2000.

¹⁴ Spyropoulos 1972; Blackwell 2018.

¹⁵ Karo 1930, esp. 139. – For the Tiryns treasure see now Maran 2006, esp. 129–142.

¹⁶ Kleitsas et al. 2018.

¹⁷ Hansen 1996; 2013; 2016; 2020. – See also Clausing 2003, 152.

Fragmented Objects in Greek Sanctuaries

In fact, the Panhellenic sanctuary of Olympia and other Greek sanctuaries are extremely interesting sites for the study of fragmented metal objects and the social/ritual practise of fragmentation in detail. In Olympia alone, more than 30,000 bronze objects dating mainly to the first half of the first millennium BC have been discovered since German excavations started in 1875. Many of them have come down to us in a fragmentary condition, and traces of deliberate damage can frequently be seen on them. Even though the fragmentary state could hardly be overlooked, the significance of the practise of fragmentation has rarely been scrutinised in detail up-to-now. Already the great German archaeologist Adolf Furtwängler (1853–1907) recognised in his masterly work on the bronzes and other small finds from Olympia that the destruction of bronze votive offerings and their fragmentation had begun quite early:

»Die Zerstörung der älteren Bronzeweihgeschenke und die Zersplitterung der Fragmente hat schon in recht früher Zeit begonnen. Dafür sind namentlich die Reste gewisser sehr stattlicher DreifüÙe ein Beweis, deren Blechplatten schon im 6. oder gar 7. Jahrhundert v. Chr. zu Inschriften verwendet und zurecht geschnitten wurden [...]. Auch hat man öfter ursprünglich zusammengehörige Stücke [...] an den entgegengesetzten Enden der Altis gefunden. Diese Thatsache frühzeitiger Zersplitterung und Verschleppung einzelner Stücke hindert aber nicht alle aus dem Fundorte auf die ursprüngliche Aufstellung zu machende Schlüsse«¹⁸ (The destruction of the older bronze votive offerings and the splintering of the fragments began quite early. This is evidenced by the remains of certain very stately tripods, whose sheet metal plates were used for inscriptions and cut to size as early as the 6th or even 7th century BC [...]. Pieces that originally belonged together [...] have been found at opposite ends of the Altis. This

fact of early fragmentation and displacement of individual pieces, however, does not prevent all of the conclusions to be drawn from the place of discovery as to the original arrangement).

It took almost 100 years until the phenomenon of the destruction and fragmentation of votive gifts in Olympia was looked at more intensively, albeit only in brief studies from the 1980s, for example by Alistar Jackson, Heide Frielinghaus or Astrid Lindenlauf¹⁹. Previously, it seemed often sufficient to point out that bronze votives became unsightly after a long period of display and were then dismantled, removed or melted down by order of the sanctuary administration.

However, the key question, which applies to Bronze Age hoards in the same way, has not been asked for a long time: Why did bronze objects in a fragmentary state of preservation end up in the ground in such large quantities in Olympia and in other Greek sanctuaries, and why were they not completely recycled or re-used for sanctuary purposes? From an economic point of view, this seems hardly comprehensible. The bronze legs and handles of cast Geometric tripods from Olympia alone have a total weight of almost 800 kg²⁰, which represents a considerable value. If there had been a consistent »waste management«, one would have to expect a much smaller quantity of metal finds, limited to small discarded or unintentionally lost pieces. Hence, the key question is basically the same for Bronze Age scrap hoards and fragmented bronze votive offerings in Greek sanctuaries.

A significant and concise contribution to this topic was published in 2006 by the former president of the German Archaeological Institute, Helmut Kyrieleis, in his volume on the excavations at the Pelopion in Olympia, the sacred district of the mythical hero Pelops – the namesake of the »Peloponnese« – located immediately north of the Early Classical temple

¹⁸ Furtwängler 1890, 2.

¹⁹ Jackson 1983; Frielinghaus 2006; Lindenlauf 2006.

²⁰ See Scarci/Stawinoga, this volume.

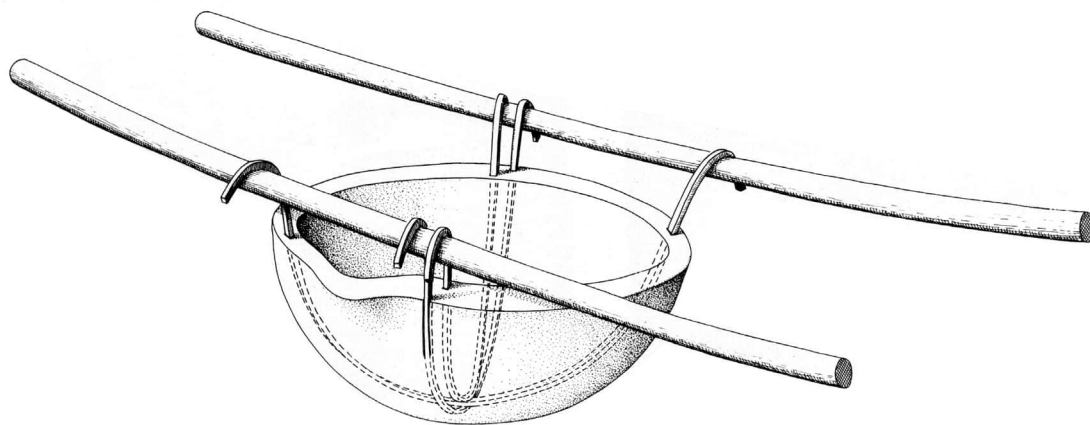


Fig. 3 Reconstruction of a movable casting crucible from Olympia. – (After Völling/Zimmer 1995, 664 fig. 6).

of Zeus²¹. Kyrieleis stated that numerous bronze objects had been:

»verbogen, zerbrochen oder gewaltsam aus ihrem ursprünglichen Zusammenhang gerissen [...], bevor sie unter die Erde gekommen sind« (bent, broken or violently torn from their original context before they went underground) and »dass die meisten dieser Beschädigungen und Zerstörungen nicht zufällig oder durch spätere Erdbewegungen etc. entstanden sind, sondern auf absichtliche Gewalteinwirkung zurückgehen«²² (that most of these damages and destructions were not accidental or caused by later earth movements, but were the result of deliberate violence).

In particular, the numerous Geometric tripods show clear traces of intentional destruction, not only in Olympia, but also in other Greek sanctuaries with supra-regional significance such as Delphi, Abai/Kalapodi, Isthmia and Philia²³. The aim was obviously to break up the object, often with considerable force. As Furtwängler already recognised in 1890, stratigraphic observations show that the destruction already took place in the heyday of the sanctuary in the Archaic and Classical periods, from the 7th to the 4th century BC. From this, Kyrieleis concluded that it

was not a case of metal theft, but that this was »doch wohl nur mit Zustimmung bzw. im Auftrag der Heiligtumsverwaltung denkbar«²⁴ (only conceivable with the consent or on behalf of the sanctuary administration). Since sacral regulations prevented the removal of discarded votive offerings from the sanctuary (*ouk ekphora*), most of them were melted down for the purposes of the sanctuary, whereas »die nicht in den Schmelzöfen gewanderten Teile der zerlegten Votive aus kultischen Gründen aufbewahrt wurden, um als *pars pro toto* im Besitz der Gottheit zu verbleiben«²⁵ (the parts of the dismantled votives that were not melted down were kept for cultic reasons, to remain in the possession of the deity as *pars pro toto*).

Metal workshops and residues of bronze casting such as slags, ingots or half-finished products are frequently attested in Greek sanctuaries, not only in Olympia²⁶. Many craftsmen must have worked in the sacred district to construct all the temples and buildings, to expand and maintain the infrastructure and to produce new or dismantle old votive offerings. Following Kyrieleis, fragments of larger votive offerings would therefore have been deposited in the sanctuary in a secondary (ritual) act. This picture largely corresponds to that which Tullia Linders made probable for more recent periods on the basis

²¹ Kyrieleis 2006, 95–98.

²² Kyrieleis 2006, 95.

²³ Olympia: Willemsen 1957; Maaß 1978. – Delphi: Rolley 1977. – Kalapodi: Felsch 2007, 30–41 nos 1–57 pls 5–7. 13–15. – Isthmia: Raubitschek 1998, 77–83 nos 295–302 pls 46–48. 50. – Philia: Kilian-Dirlmeier 2002, 7–8 nos 1–2 pl. 1.

²⁴ Kyrieleis 2006, 96.

²⁵ Kyrieleis 2006, 97.

²⁶ E. g. Heilmeyer 1969; 1981; Heilmeyer et al. 1987; Zimmer 1990; Voyatzis 2004, 190–191; Baitinger/Völling 2007, 207–213; Verdan 2007; Nordquist 2014, 157–178; Kiderlen et al. 2017; Fuchs 2019. – Summarising Risberg 1992; 1997.

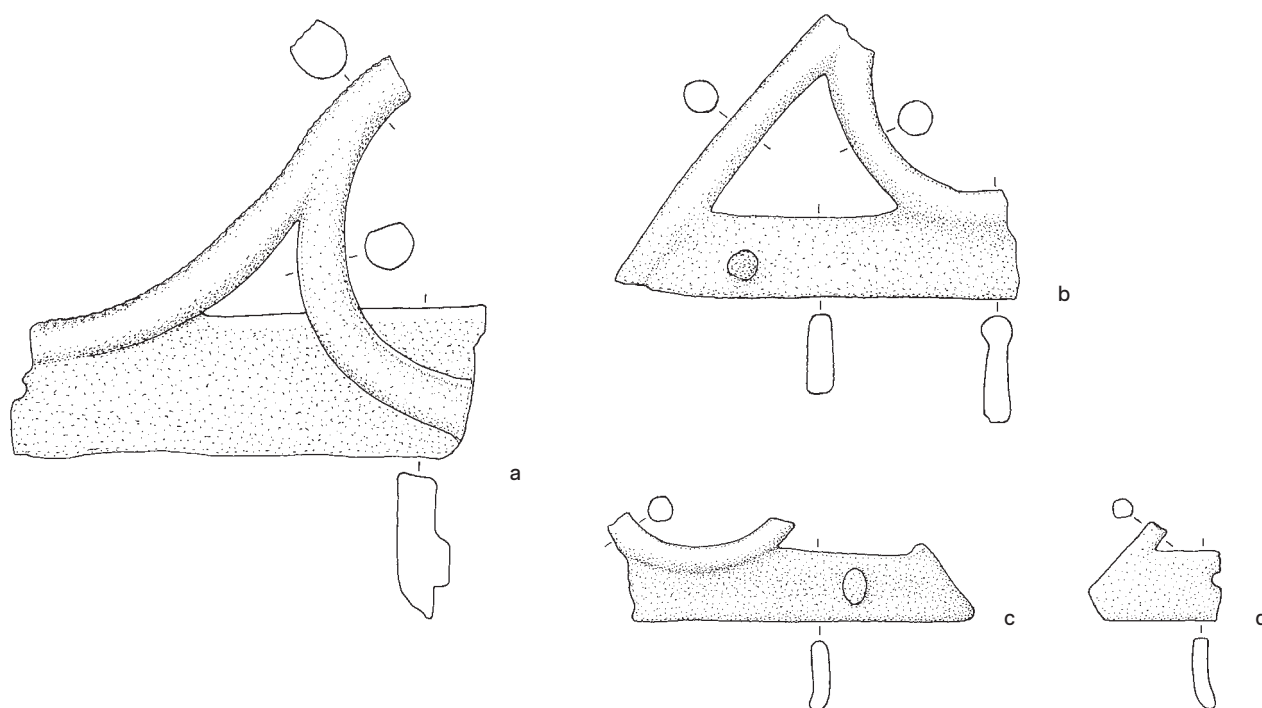


Fig. 4 Fragmented Sicilian bronze cauldron handles from Olympia (a-d). – (Drawings H. Baitinger/M. Weber, LEIZA). – Scale 1:2.

of written sources²⁷. However, a specific area for such »re-depositions« cannot be determined in Olympia: fragmented objects were found in altar layers such as the famous »black layers« in the Pelopion area²⁸ as well as in wells or back-fillings in the stadium or in the southeast area. The find contexts therefore do not always unequivocally prove a sacred background for the (re-)deposition, but allow a broader spectrum of interpretation – even if this is often difficult to decide in a sanctuary whose central areas were already uncovered in the 19th century.

Legs of Geometric tripods and other huge bronze objects were broken into sometimes quite small pieces which would have made it possible to melt them down in a casting crucible. Movable crucibles with iron reinforcement and a diameter of approximately 40 cm for casting statues or other large bronzes have actually been found in Olympia (**fig. 3**)²⁹. As in Bronze Age scrap hoards, huge bronze objects –

like Geometric tripods³⁰ – survived only fragmentarily while small objects – like Geometric votive animals³¹ – were rarely affected by demolitions³². Therefore, we cannot postulate binding sacral regulations for the destruction of discarded votives in Olympia, at least for the Geometric period.

Quite interesting are strong similarities between bronzes of Sicilian origin discovered in Olympia and objects from several scrap hoards of the Early Iron Age in Sicily. This applies not only to the types represented, but also to their largely fragmentary state of condition. Olympia has produced eight specimens of Sicilian cauldron handles dating to the 8th or 7th century BC, four of which are only fragmentarily preserved (**fig. 4a-d**)³³. In the huge metal hoard from Mendolito di Adrano near Catania, of the 29 cauldron handles of this type only three have survived in their entirety³⁴. Of the 215 bronze spearheads from the Mendolito hoard, only 30 are preserved as com-

²⁷ Linders 1989/1990.

²⁸ Kyrieleis 2006, 27–55.

²⁹ Zimmer 1990, 57–60; Völling/Zimmer 1995.

³⁰ Willemsen 1957; Maaß 1978.

³¹ Heilmeyer 1979.

³² Following Bocher 2013, 357–360, most elements of Geometric tripods were heavily fragmented, while 91 % of the small bronze votive animals were still intact.

³³ Baitinger 2013, 242–251 fig. 125.

³⁴ Albanese Procetti 1993, 147–148 nos M 400–M 428 fig. 45 pls 34–36; 187–190 (type M 15).



Fig. 5 Fragmented bronze shaft-hole axe from Olympia with traces of deliberate damage. – (Photo H. Baitinger).

plete³⁵. In some cases, they show bending and chiselling marks proving an intentional but not accidental destruction. The apparently similar treatment of the pieces in Sicily and Olympia may suggest a similar ritual or economic background, and I have already asked the question if these bronzes have come to Greece in their entirety or as a conglomerate of scrap metal in the sense of a »pre-monetary« dedication³⁶.

The front part of the blade of an Italian shaft-hole axe from Olympia has been chipped off, as shown by chiselling marks on the top (**fig. 5**)³⁷. Accidental breakage when using the axe can therefore be ruled

out, also because the tool is not broken at a predetermined breaking point (*Sollbruchstelle*) and there are no visible blowholes which could be responsible for the breakage. Similar damage can be detected also on an axe from the Mendolito hoard³⁸ and on other axes from Italian find spots. They all originate from hoards such as the enormous one from San Francesco di Bologna³⁹, while the few pieces discovered in tombs are always completely preserved⁴⁰. This raises the question of whether the axe from Olympia originally belonged to the stock of an Italian scrap hoard before being transferred to the Peloponnese⁴¹.

An important aspect for interpreting the phenomenon of fragmentation in Olympia is the distribution of matching fragments within the sanctuary, a question already raised by Furtwängler⁴². He observed a sometimes very wide scattering of pieces that originally belonged together and could be potentially re-fitted. An example concerns the bronze fitting strips with silver nails from Olympia initially belonging to the substructure of a silver *sphyrrelaton* similar to the famous silver bull from Delphi⁴³. This precious sculpture dating to the 6th century BC was dismantled and taken apart after a quite short lifespan in the Early Classical period. The 15 preserved fragments were found widely scattered, but nevertheless concentrated in three areas in the northwest of the stadium, in the southeast district and at the Prytaneion in the northwest of the Altis (**fig. 6**). Hence, there is no question of a completely random distribution within the sanctuary. One wonders to what extent the position of metal workshops could have played a role here. At least in the area of the northern embankment of the stadium and in the southeast district evidence of bronze casting and other craft activities is proved⁴⁴, so that a connection seems possible.

³⁵ Albanese Procetti 1993, 119–139 nos M 98–M 307 figs 28–40 pls 22–28A; 178–181 (type M 3).

³⁶ Baitinger 2013, 162. 239. 280–281; 2018, 24.

³⁷ Baitinger/Völling 2007, 11–13 no. 1 pl. 1; Baitinger 2013, 253–255 figs 137–138.

³⁸ Albanese Procetti 1993, 140 no. M 317 fig. 41 pl. 29.

³⁹ Carancini 1984, 200 no. 4248 pl. 154; 202–203 nos 4262–4267 pl. 155; 206 nos 4281–4282. 4285 pl. 156; 207 no. 4287 pl. 157; 209–210 nos 4301–4302. 4308 pl. 158; 213 no. 4328 pl. 160; 218 no. 4364 pl. 163; 219 nos 4377. 4379 pl. 164; 223–224 nos 4411. 4414–4416 pl. 167; 226 no. 4431 pl. 168; 226–228 nos 4434–4436. 4438–4440.

4442–4446 pl. 169; 229–230 nos 4453–4454. 4458. 4460–4461 pl. 170.

⁴⁰ Carancini 1984, 198 no. 4234 pl. 153 (prov. Trento/IT) (?); 199–200 no. 4243 pl. 153 (Territorio del Fucino, prov. L'Aquila/IT); 201 no. 4249 pl. 154; 210–211 no. 4311 pl. 159; 220 nos 4385. 4390 pl. 165 (all from Cumae, prov. Napoli/IT) (?); 224 no. 4418 pl. 167; 227 no. 4437 pl. 169 (both Valentano, prov. Viterbo/IT).

⁴¹ Baitinger 2013, 255.

⁴² Furtwängler 1890, 2.

⁴³ Baitinger 2010.

⁴⁴ Baitinger/Völling 2007, 207–213.

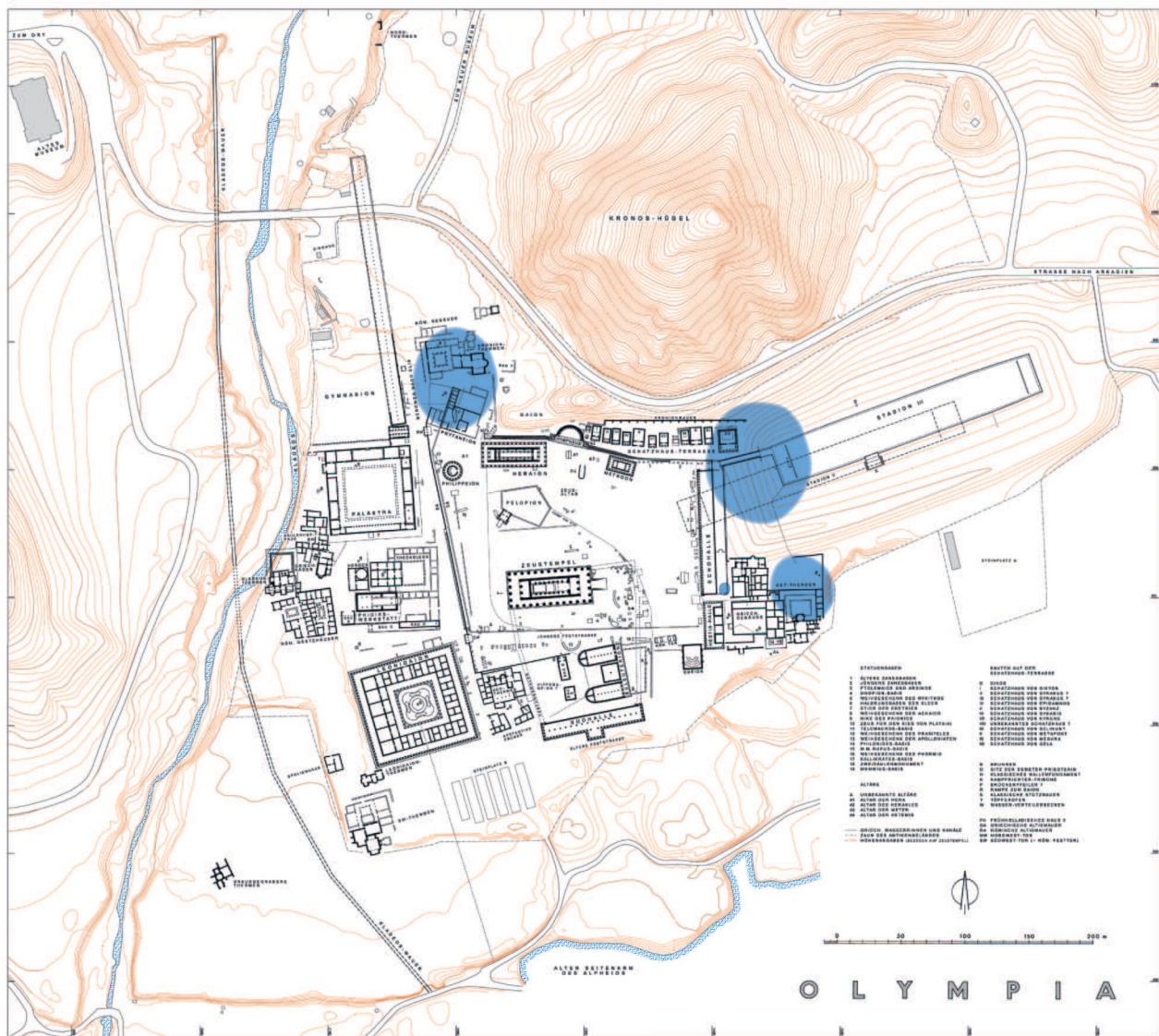


Fig. 6 Distribution map of bronze fittings with silver nails from a silver *sphryrelaton* discovered in Olympia. – (Graphics M. Ober, LEIZA, based on the plan of Olympia of the DAI Athens).

However, one must also be aware that intentional damage and destruction is only one side of the coin. The phenomenon of fragmentation has many facets that are not always easy to grasp. Therefore, one should beware of hasty conclusions and interpretations before one has carefully evaluated the complete archaeological evidence and context. The destruction of objects need not have taken place immediately before the fragments were buried but may

have occurred some time earlier, although it is not always clear what role the fragments played at that time. They may have been damaged during their use, during their capture (e. g. arms and armour), during their dedication, during their display in the sanctuary or at the moment of their dismantling, although even this need not have been the final act in the object's biography. Ancient votive offerings were sometimes re-used in Olympia in a very pragmatic way,



Fig. 7 Fragmented bronze spear butt re-used as a chisel. – (Photo P. Grunwald, DAI Berlin, D-DAI-ATH-1997/2171).

which may have also left traces of damage. Just to name a few examples: a huge bronze cauldron of the 7th century BC was re-used much later as a water basin in a bronze foundry of the Classical period below the workshop of Phidias⁴⁵. Ignorance of the context may have led to false conclusions. An iron roasting spit (*obelos*) must have been used in the same foundry, as shown by the corresponding imprint on the fragment of a casting mould discovered there⁴⁶. The socket of a square-edged bronze spear butt is broken off, the point is bent, and traces of hammer blows at

the breakage are clearly visible (**fig. 7**)⁴⁷. The fragmented weapon was obviously re-used by a craftsman as a chisel. How can we differentiate between various types of damage if the evidence is less clear? Furtwängler already mentioned fragments of Geometric tripod legs of the 8th century BC which were later re-used as bearers of inscriptions (**fig. 8a–b**)⁴⁸. Indeed, it was not a problem to turn such a bronze plate over and to inscribe it. Previously, the tripod leg had to be shortened to the desired length of the inscription, i. e. it was reduced to a fragment and then re-used in a completely different function. The inscription plate was mounted on stone or wood so that the decoration on the original front side became invisible – and its original function could not be recognised any more by the viewer in antiquity. The complex »biography« of such an object is only revealed to today's archaeologists. The same holds probably true for fragments of Villanovian crested helmets from Northern Italy discovered in Delphi and in Olympia⁴⁹. Another fragment of such a helmet came to light in a 6th century BC temple in Calabria⁵⁰, and one wonders whether anyone even knew what it was, whether it was simply a curiosity or whether the metal value was the centre of attention. Unlike in Delphi and Olympia, the most massive part of the helmet – the front plate – has survived here as the element which is considered to have the best chance of being preserved.

All the questions raised in this contribution seemed worthy of a more detailed and systematic analysis, which is why we applied for a three-year research project at the German Research Foundation⁵¹. Since January 2022, Azzurra Scarci has been working on this project, supported in recording the material by Gerhard Stawinoga, a very experienced conservator, who was able to make important contributions with his expertise⁵².

⁴⁵ Mallwitz/Schiering 1964, 44 fig. 20; Heilmeyer et al. 1987; Zimmer 1990, 39–50, esp. 39–41. – For the cauldron see Gauer 1991, 23. 179 Le 11 fig. 6, 4.

⁴⁶ Heilmeyer et al. 1987, 284 no. 9 fig. 42; Völling/Zimmer 1995, 665–666 fig. 7.

⁴⁷ Baitinger 2001, 59. 197 no. 1007 pls 48. 76a.

⁴⁸ Furtwängler 1890, 2; Dittenberger/Purgold 1896, 7–16 nos 3–5; Maaß 1978, 2 note 12; 183 no. 210a pl. 51; 188 no. 224a; 195 no. 247a–b pl. 54.

⁴⁹ Kilian 1977; Frielinghaus 2007, 149 no. 1; 2011, 1–2. 235 no. A1.

⁵⁰ La Torre 2002, 282 no. O 164 fig. 57; 2011, 69–73 fig. 3.

⁵¹ DFG GZ BA 3197/2–1, project number 466820328. – We would like to thank the German Research Foundation for the funding of this project.

⁵² See Scarci/Stawinoga, this volume.

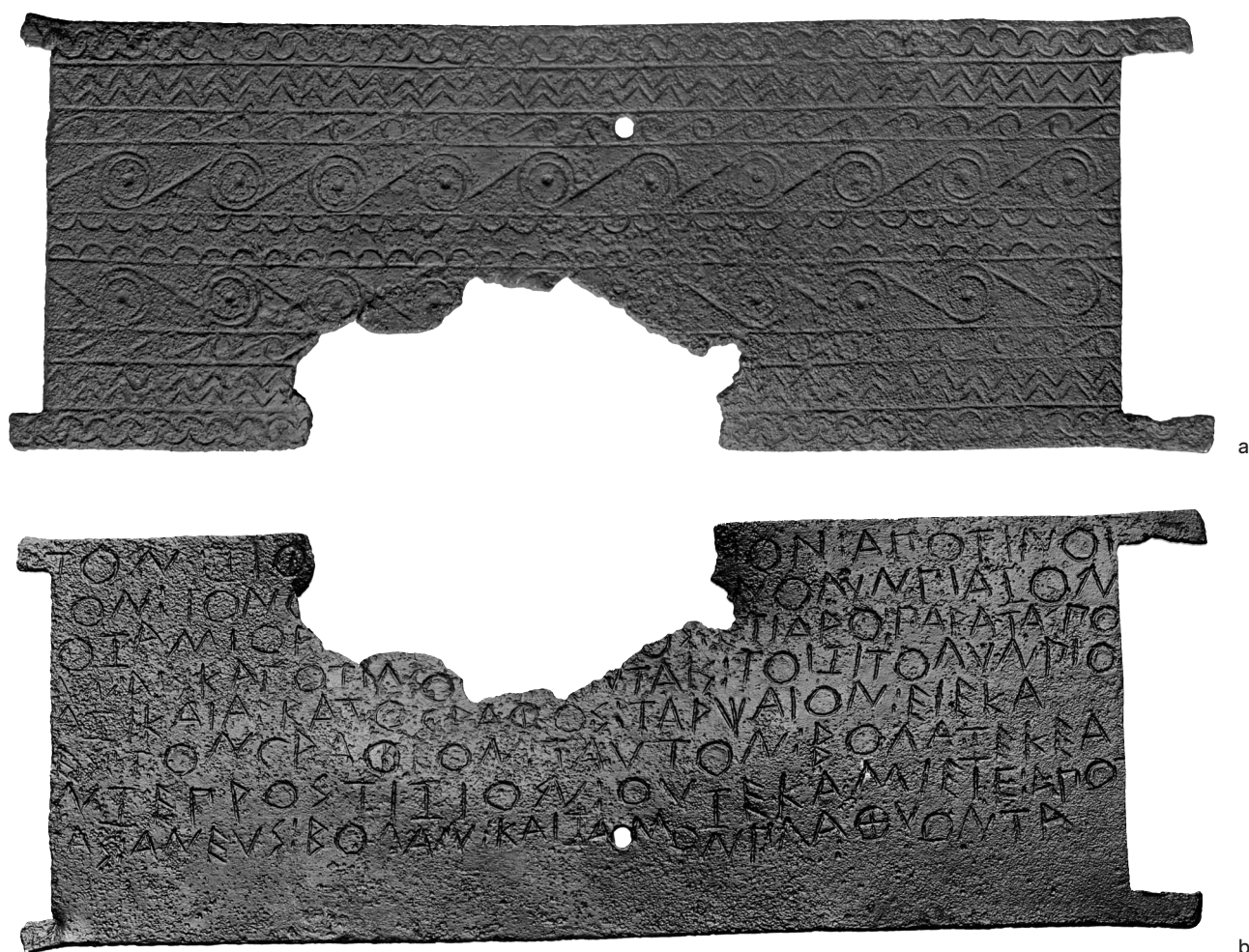


Fig. 8 Fragmented bronze leg of a hammered tripod with an Archaic inscription on the back side from Olympia (a-b). – (Photos H. Wagner, DAI Athens, D-DAI-ATH-Olympia 1516, D-DAI-ATH-Olympia 1585).

Conclusions

Svend Hansen has rightly stated that »the fragmentation of objects is a cultural practise with multifaceted aspects«⁵³. Therefore, the spectrum of interpretations of fragmented votive offerings, cult equipment, fitting elements, parts of »everyday life« or other metal objects in Olympia and in other Greek sanctuaries is quite broad and must be analysed in a differentiated manner. This is related to the ambivalent character of scrapped bronzes, which could be used as raw materials for recycling, as a store of value or as a medium of exchange – if they are not simply accidentally lost objects or »waste«. Therefore, the following list of interpretations for fragmented

objects in Greek sanctuaries is for sure incomplete and still to be extended:

1. Fragmented bronze votive offerings can relate to metal workshops working on the edges of the sacred district and using dismantled votive offerings for melting them down.
2. Fragmented bronze votive offerings may have been largely recycled and melted down again, while a small part of it was re-dedicated or re-deposited in the sanctuary as *pars pro toto* following the regulations of *ouk ekphora* (H. Kyrieleis).
3. Fragmented bronze objects may have reached Olympia as »pre-monetary« dedications owing

⁵³ Hansen 2016, 199.

to their material value, especially from the west of the Greek world.

4. At least some of the fragmented objects must have been lost by chance or deliberately discarded, especially small pieces like fibulae, jewellery and so on.
5. Fragmented objects could be re-used in the sanctuary in a pragmatic way which would have caused the loss of their original function and their completeness.
6. Among the fragmented bronzes may also be discarded votive gifts which have been intentional-

ly damaged in the sense of a »ritual killing«, an explanation very often given by archaeologists but quite seldom proved by a detailed analysis of both the object itself and its context. Such an explanation requires most careful evaluation.

The systematic analysis of fragmentation processes in Greek sanctuaries is still in its infancy and promises important new insights, especially when compared with and utilising the methods of prehistoric archaeology. In this paper, I present some initial results but we can expect many more insights in the future.

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Fragmentation as Ritual Practice?

New Insights from the Sanctuary of Olympia*

ABSTRACT

This paper examines the intentional fragmentation of bronze votive offerings in the sanctuary of Olympia, with a focus on Early Iron Age cast tripod cauldrons and Sicilian-Italic spearheads. Patterns of deliberate fragmentation emerge from metalwork wear analysis and statistical methods, suggesting diverse motivations underlying this practice. The study questions traditional interpretations of fragmentation, exploring its potential roles beyond *pars pro toto*. The findings challenge simplistic models and highlight the necessity of further spatial and contextual analyses for a full understanding of the inherent socio-cultural dynamics.

KEYWORDS

Olympia | Early Iron Age | fragmentation | copper-alloy votive offerings | metalwork wear analysis | statistical methods

The deliberate fragmentation of copper-alloy votive offerings in sanctuaries across Greece and southern Italy from the Early Iron Age (EIA) onwards has received increasing scholarly attention in recent decades (Verger/Pernet 2013; Baitinger 2021; Tarditi 2021). This phenomenon was first documented at Olympia by A. Furtwängler in 1890 (Furtwängler 1890, 2); later, H. Kyrieleis drew parallels between it and Late Bronze Age hoards in Europe (Kyrieleis 2006, 97; *contra* Gimatzidis 2021, 171). Given its long history, Olympia serves as a key site for investigating the implications of this widespread practice.

This research aims to deepen our understanding of the intrinsic meaning of fragmentation and its potential connections to European hoarding traditions. We have used methodologies from prehistory and protohistory, such as metalwork wear analysis and both descriptive and multivariate statistical approaches. Additionally, a GIS-based spatial and contextual analysis is being conducted, drawing on excavation data collected since 1875.

Preliminary findings from material and statistical analyses are promising. This paper focuses on two material groups within the broader dataset: EIA cast tripod cauldrons and Sicilian-Italic spearheads from the Iron Age (IA).

Cast Tripod Cauldrons

Tripod cauldrons held significant social, political and religious value in EIA Greece. These often elaborately decorated bronze objects served diverse

functions, including food preparation, religious rituals, votive offerings, prestige gifts, and prizes in funerary and literary contests (Papalexandrou 2005;

* The paragraph »Results of the Metalwork Wear Analysis« was written by Gerhard Stawinoga, the remainder of the study by Azzurra Scarci.



Fig. 1 The only complete tripod cauldron from Olympia (B 1240). – (Photo G. Hellner, DAI Athens, D-DAI-ATH-1974/1108).

Gimatidis 2021). Their importance in the social and political fabric of EIA Greek society is underscored by their frequent depiction in Greek Geometric art (Wilson Jones 2002), references in poetic works (Papalexandrou 2005, 9–63; Gimatidis 2021, 166–168), and their presence at major sanctuaries such as Olympia, Delphi, and Kalapodi (Kiderlen et al. 2017, fig. 2).

Except for one completely preserved tripod cauldron (**fig. 1**) and approximately nine nearly complete examples, tripod cauldrons found at Olympia predominantly comprise isolated handles ($n = 323$) and legs ($n = 473$), which had been removed from their vessels and then deliberately fragmented (**fig. 2**).

Metalwork wear analysis and statistical methods reveal systematic patterns of deliberate dismantling and destruction.

Results of the Metalwork Wear Analysis

A detailed metalwork wear analysis of cast tripod cauldrons from Olympia (for classification and chronology see Kiderlen 2010; Kiderlen et al. 2016, 304–305) identified three distinct tool types employed in their dismantling:

- 1) Flat tools: implements such as hammers, mallets or axe necks created widespread flattening through material displacement (Scarci 2024, 18 fig. 5). In tripod legs of Types 4–5, which were obtained by welding two side panels to a frontal one, fractures and bending commonly occurred at the joints. Similarly, open-worked handles of Type 4 show deformations due to the flat tool's impact (**fig. 3**). The larger the tool's impact surface, the greater the force applied, resulting in more extensive damage.
- 2) Rounded tip tools: featuring a rounded tip often found in hammers or mallets with fins, blunt wedges, chisels, picks, or pickaxes, this tool left rounded notches (Scarci 2024, 18 fig. 6). Penetration is usually shallow but can lead to fractures, particularly at hollow points, where impact is concentrated.
- 3) Sharp-edged tools: sharp-edged implements like axes, hatchets or chisels, caused deep penetrations, resulting in blow marks, smooth surfaces, V-shaped notches, and indentations along the object's edges (Scarci 2024, 18 figs 7–8). The displaced material forms slight bulges at the penetration side, and these impacts could lead to fractures and edge breakage.

The presence of these tools at the sanctuary of Olympia is well documented (Baitinger/Völling 2007).

Following tool identification, detailed observations of damage patterns (e. g. notches, blow marks, flattening, indentations, bending, and fractures) enabled the reconstruction of the dismantling process (**fig. 4**). The systematic procedure suggests that skilled metalworkers were responsible for tripod destruction, leveraging their understanding of the objects' structural weaknesses to optimise efficiency.

The first phase of this process involved loosening the components of the handles that were riveted



Fig. 2 Some fragments of Geometric tripods from Olympia. – (After Scarci 2023, fig. 1).



Fig. 3 Leg fragment and handle of Type 4 with bending from Olympia (B 11635 and B 5674). – (Photo A. Scarci).

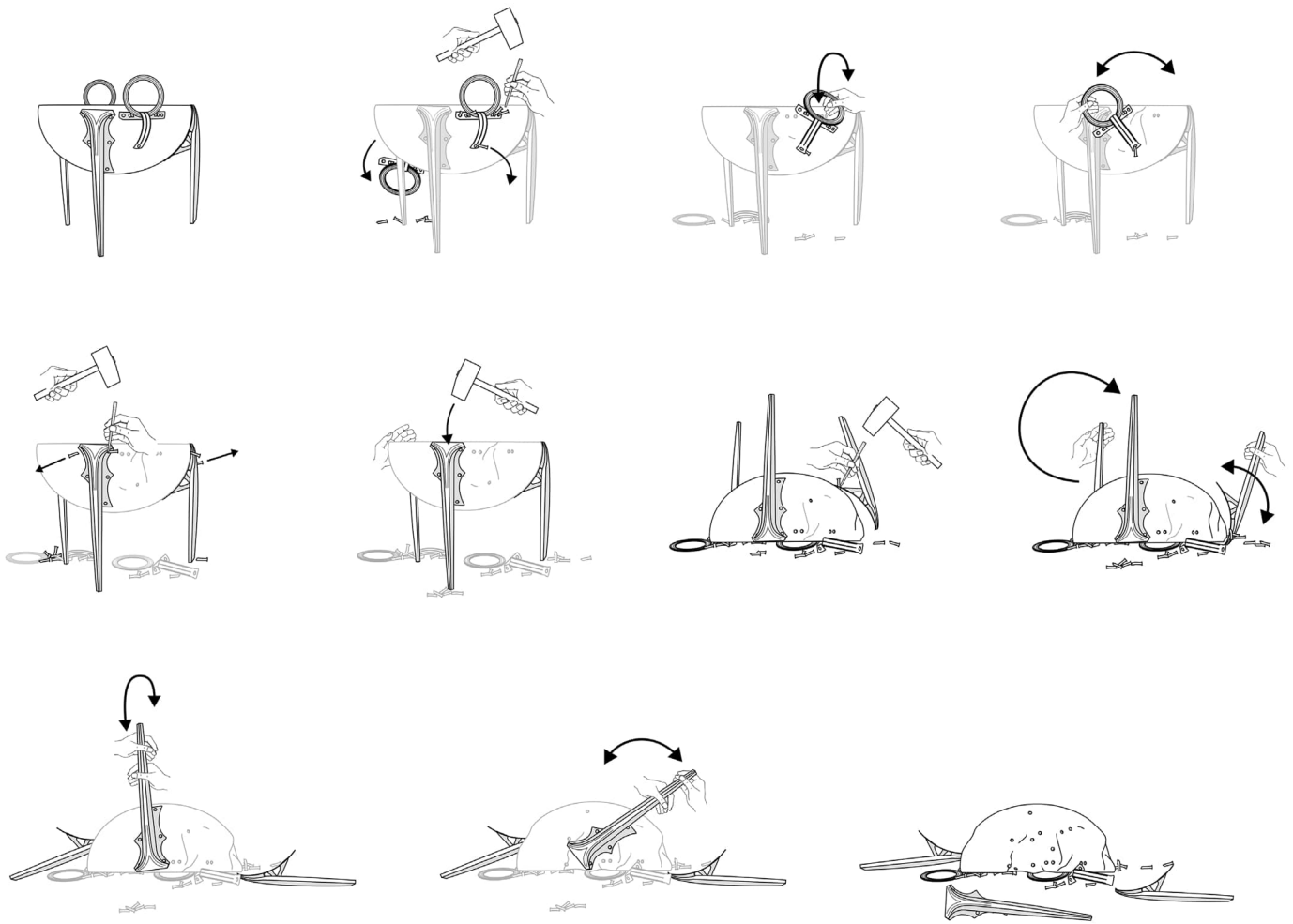


Fig. 4 Reconstructive graphic design of the dismantling process of tripod cauldrons in Olympia. – (Graphics M. Ober, LEIZA).

to the vessel, specifically the attachment plate and strap. This was achieved by applying leverage and/or impact with a tool. Once the handles were loosened, they could be detached from the vessel by exerting inward and outward pressure. Inward pressure caused the ends of the attachment plate to fracture or bend outward, while outward force led to the fracture of the vertical strap above its junction with the vessel (Scarci 2024, figs 11–12).

The second phase focused on detaching the legs. Dismantling began at the upper edge of the leg, where the rivets were either levered out or struck with a hammer from above, causing the upper part of the leg to break off or bend. Once the upper part was loosened, the tripod cauldron was inverted, allowing the lower rivets to be loosened. The legs were then pulled inward, outward, and sideways until either the rivets came off or the vessel broke (Scarci 2023,

66–67 figs 5–8). In case of breakage, the cauldron's metal sheets remained attached to the leg supports.

An alternative method entailed the destruction of the vessel itself, thereby facilitating the removal of handles and legs (Scarci 2023, 67 fig. 9). Once separated, the components (handles and legs) were fragmented for the purpose of fulfilling specific purposes. The fragmentation technique varied depending on the type of tripod cauldron. For example, legs of Types 4–5, made from flat and *pi*-shaped panels assembled using the lost-wax process, were more easily broken into small pieces. Breaking these legs involved detaching the side panels from the front panel by hammering, a relatively straightforward process that allowed the side panels to be reduced to small pieces with minimal effort.

Some vessels displayed severe deformation after their components were removed, likely due to their



Fig. 5 Sicilian ring handle cauldron from Olympia (B 2756). – (Photo A. Scarci/G. Stawinoga).

thin metal sheets. Notable examples include a Sicilian cauldron, flattened by its handles, possibly for efficient deposition (**fig. 5**). Sheet metal remnants might have been re-purposed in some instances.

Metalwork wear analysis has been crucial in identifying, decoding, and reconstructing the dismantling techniques and revealing substantial evidence of material degradation and loss on the undersides, particularly in the legs of the oldest type (Type 2), which show signs of prolonged exposure to cooking fires (**fig. 6**). Such tripod cauldrons were likely used for boiling water and preparing meat, as suggested by both literary and iconographic sources.

Results of the Statistical Analyses and Their Archaeological Interpretation

Upon completing the material analysis, data were standardised for statistical processing with the support of Miningful srls (Pisa). The results were then interpreted archaeologically and contextualised within their socio-cultural framework.



Fig. 6 Tripod leg with signs of fire exposure from Olympia (B 2456). – (Photo A. Scarci/G. Stawinoga).

Exploratory Data Analysis

Exploratory Data Analysis (EDA) is a crucial initial phase in statistical analysis, designed to reveal underlying patterns and structures within a dataset.

The initial step aimed to validate the findings from the material analysis of the dismantling process by organising a large set of data. This process identified five recurring dismantling variables (DVs) for handles and three for legs (**tab. 1**). Among the 323 handle specimens, 166 show DVs, while 145 out of

473 legs show DVs. The most frequent DV for handles is DV 4, while DV 3 is the most common for legs (**figs 7–8**). The frequency of DVs by type shows that both handles and legs exhibit the highest prevalence in Type 2, followed by a marked reduction in Types 3–5. Interestingly, handles of Type 4 display an increase in the occurrence of DVs (**figs 9–10**).

The analysis demonstrates that the dismantling process, attested in the Late Protogeometric type (Type 2), continued with varying intensity up to the Late Geometric type, influenced by the preserved

Component	Dismantling variable (DV)	Description
handles	DV 1	ends of the attachment plate bent or broken off
	DV 2	rivet holes of the attachment plate broken
	DV 3	lever marks, notches, and minor breakages at the edges of the attachment plate
	DV 4	strap slightly bent and/or broken off
	DV 5	lever or bent marks and breakages at the end of the strap
legs	DV 1	upper leg-plate broken or bent
	DV 2	lower leg-plate broken or bent
	DV 3	lever marks, notches, and minor breakages at the edges of the leg-plate

Tab. 1 Dismantling variables observed on tripod handles and legs.

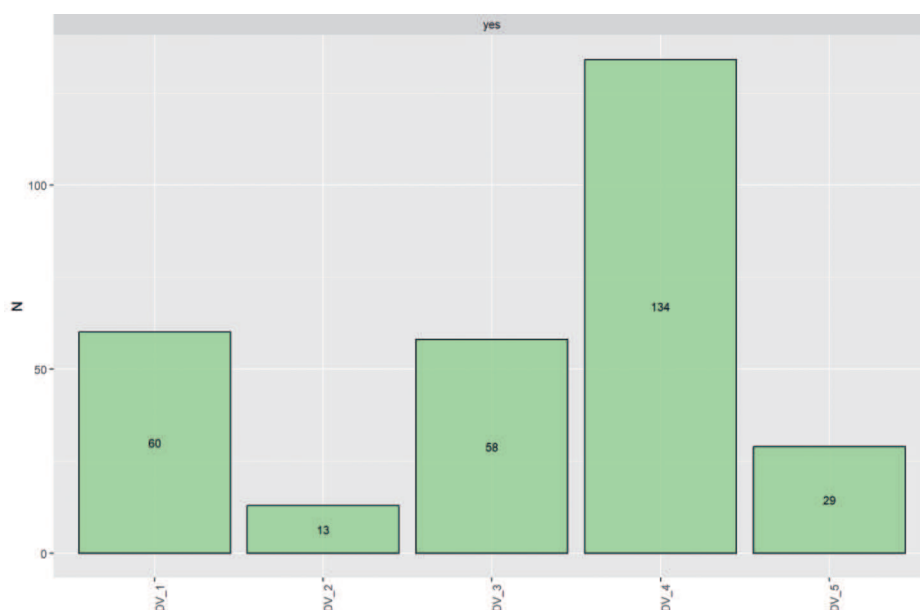


Fig. 7 Frequency of handle destruction variables. – (Graphics Miningful srls).

Fig. 8 Frequency of leg de-
struction variables. – (Graphics
Miningful srls).

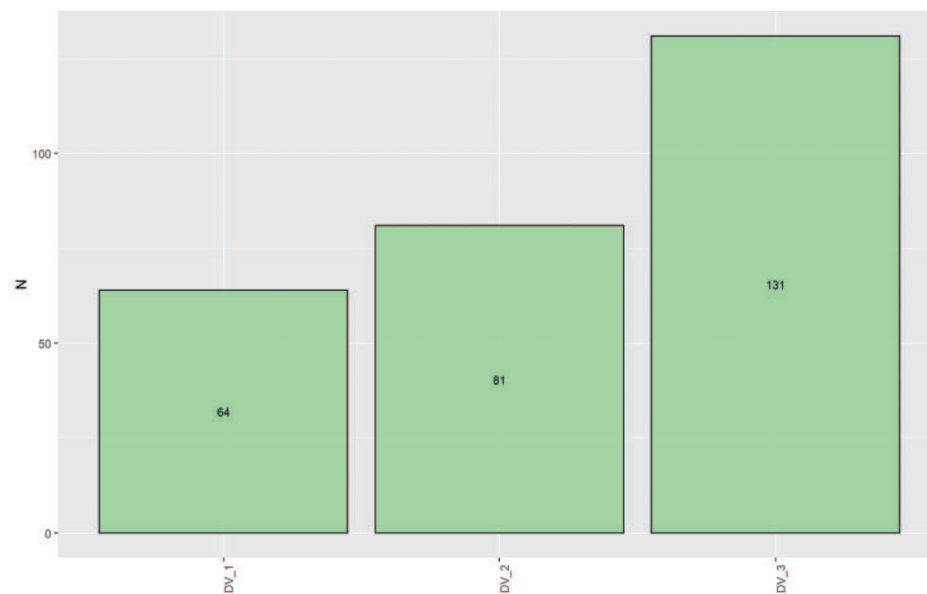


Fig. 9 Frequency of handle
destruction variables per
type. – (Graphics A. Scarci).

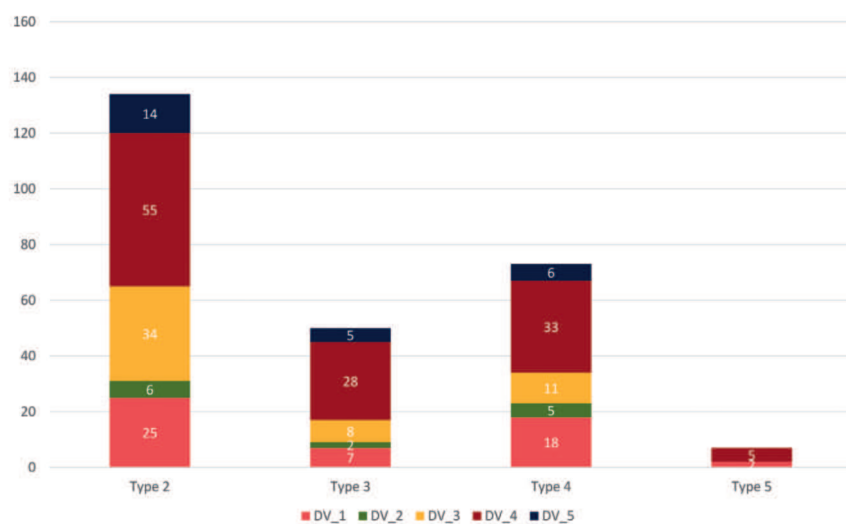
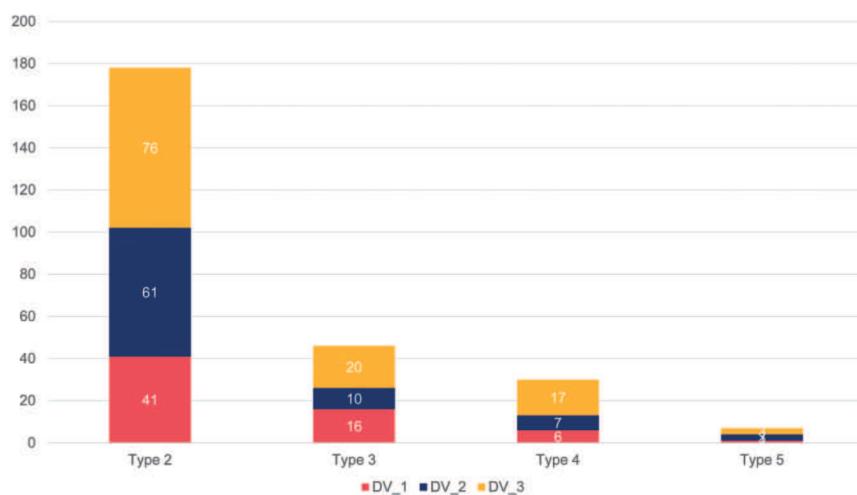


Fig. 10 Frequency of leg de-
struction variables per type. –
(Graphics A. Scarci).



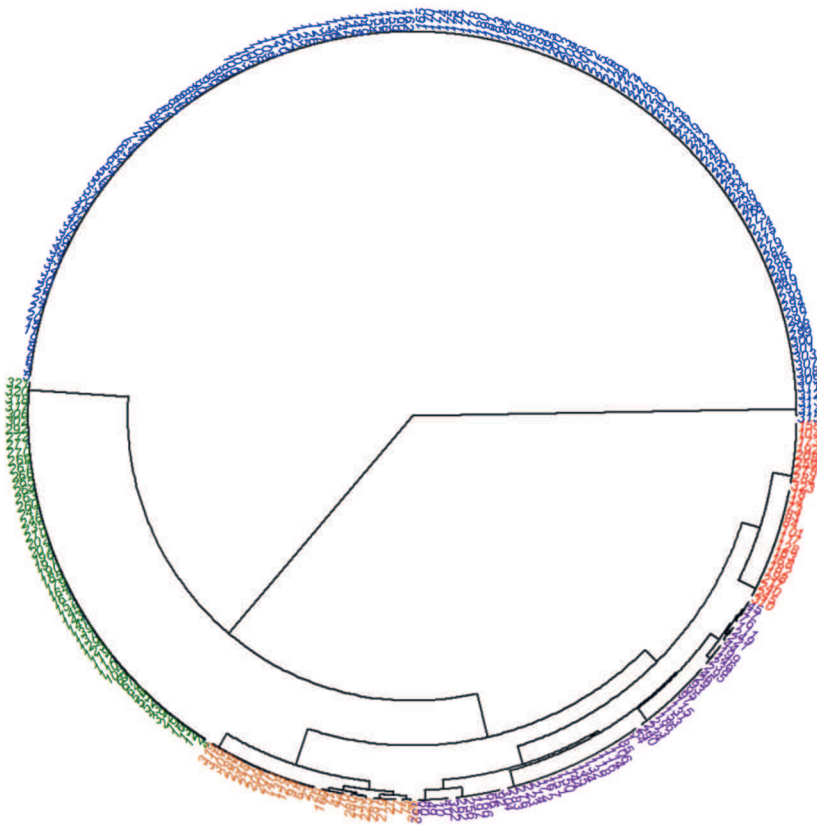


Fig. 11 Hierarchical cluster analysis of tripod handles. – (Graphics Miningful srls).

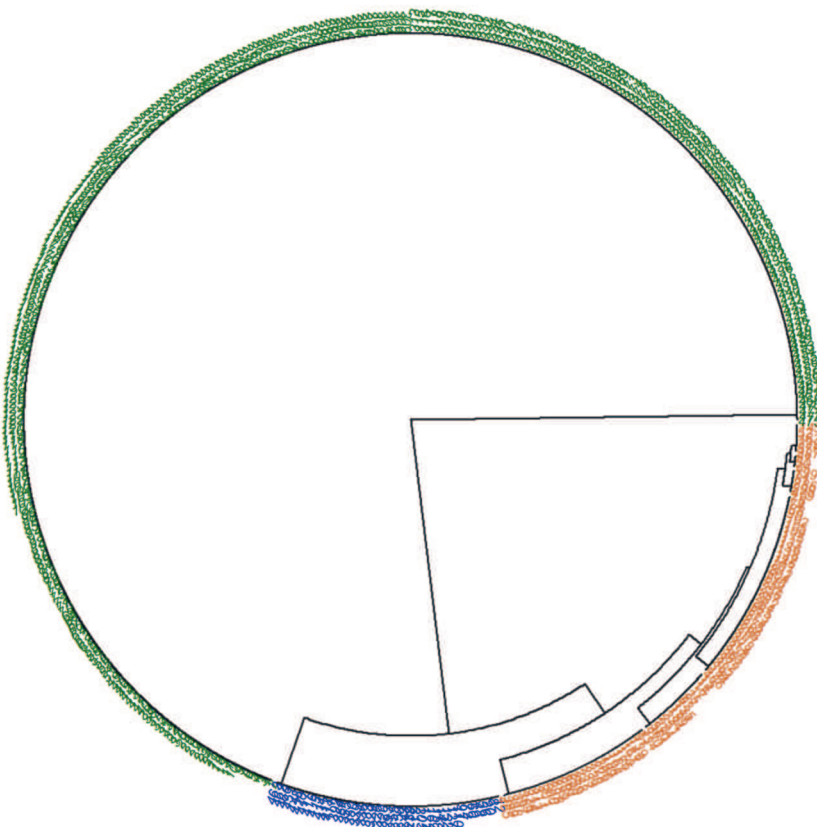


Fig. 12 Hierarchical cluster analysis of tripod legs. – (Graphics Miningful srls).

fragments. For instance, rings or fragments of leg rod do not show DVs, whereas riveted parts do. The reduction in this phenomenon for Type 5 can likely

be attributed to the decreased circulation of tripod cauldrons, which had by then become significant symbolic objects within the sanctuary. Additionally,

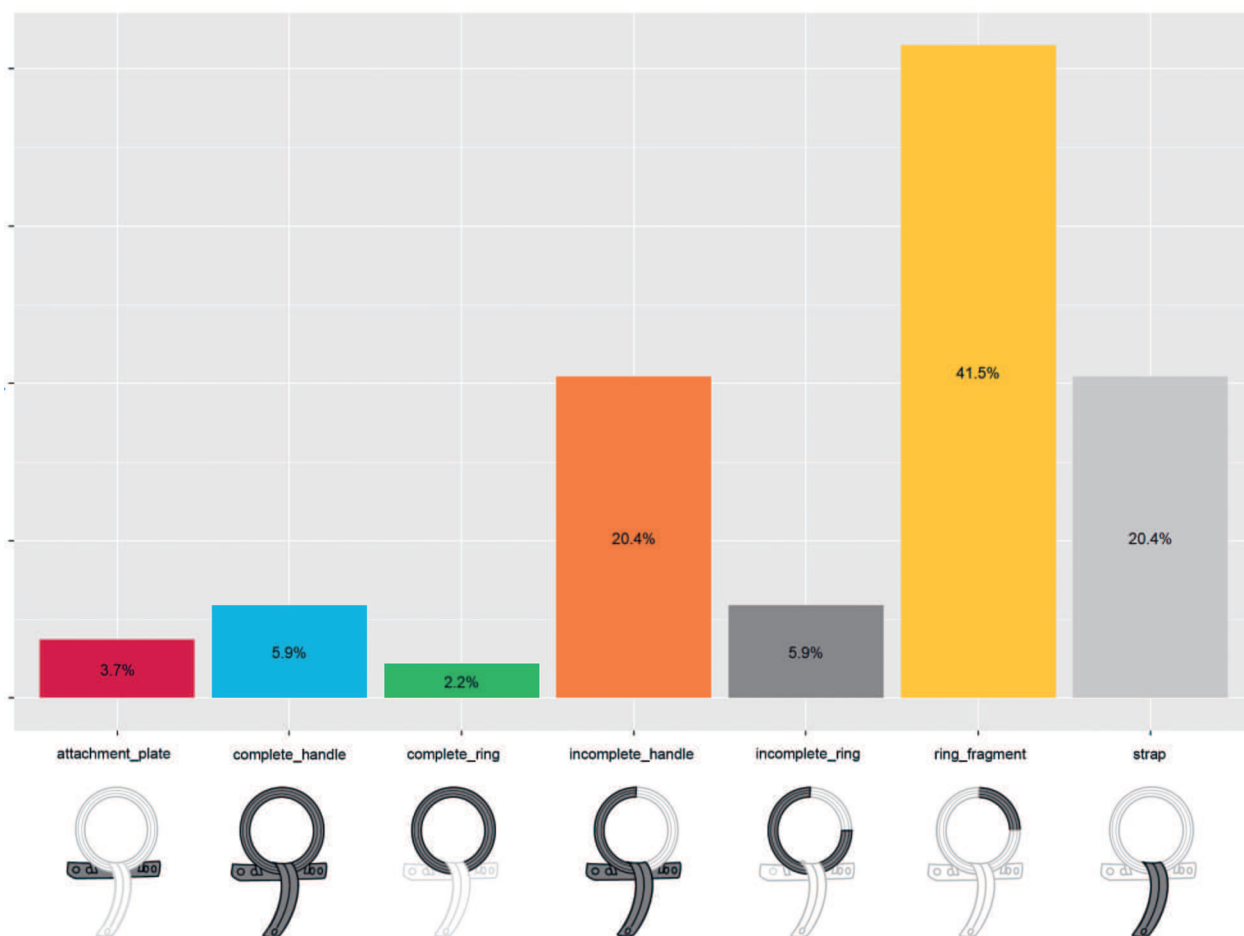


Fig. 13 Conservation index of tripod handles. – (Edited by A. Scarci from graphics by M. Ober, LEIZA, and Miningful srls).

it should be noted that, already in the Late Geometric period, tripod cauldrons were joined by griffin cauldrons as votive offerings at sanctuaries in Greece.

Given that each fragment could exhibit multiple DVs, a hierarchical cluster analysis using the Ward method was performed for both handles and legs. This analysis grouped observations based on patterns of DVs. The analysis of the handles produced five clusters. Cluster 3 (in blue) comprises observations with no DVs, while cluster 2 (in green) contains only those with DV 4. The remaining three clusters revolve around DVs 1 and 3–5 (fig. 11). The analysis of the legs resulted in three clusters: cluster 1 (in green) includes observations with no DVs, cluster 2 (in blue) consists of observations exclusively with DV 3, and cluster 3 (in orange) represents a combination of two

or three DVs, often involving DV 3 in conjunction with either DV 1, DV 2, or both (fig. 12). These results corroborate and expand upon the findings from the metalwork wear analysis.

Once the data regarding the tripod dismantling was systematised, the next step involved exploring the fragmentation of handles and legs through various analyses. First, the conservation index, as proposed by J. Chapman (2000, 67 fig. 3), was calculated for both handles and legs (figs 13–14). This analysis revealed a notable predominance of »indistinguishable« handle rings and fragments of leg rod. This result contrasts with the expected identification of a significant number of recognisable fragments, such as leg heads or incomplete handles. The discrepancy between the expected outcome and the actual re-

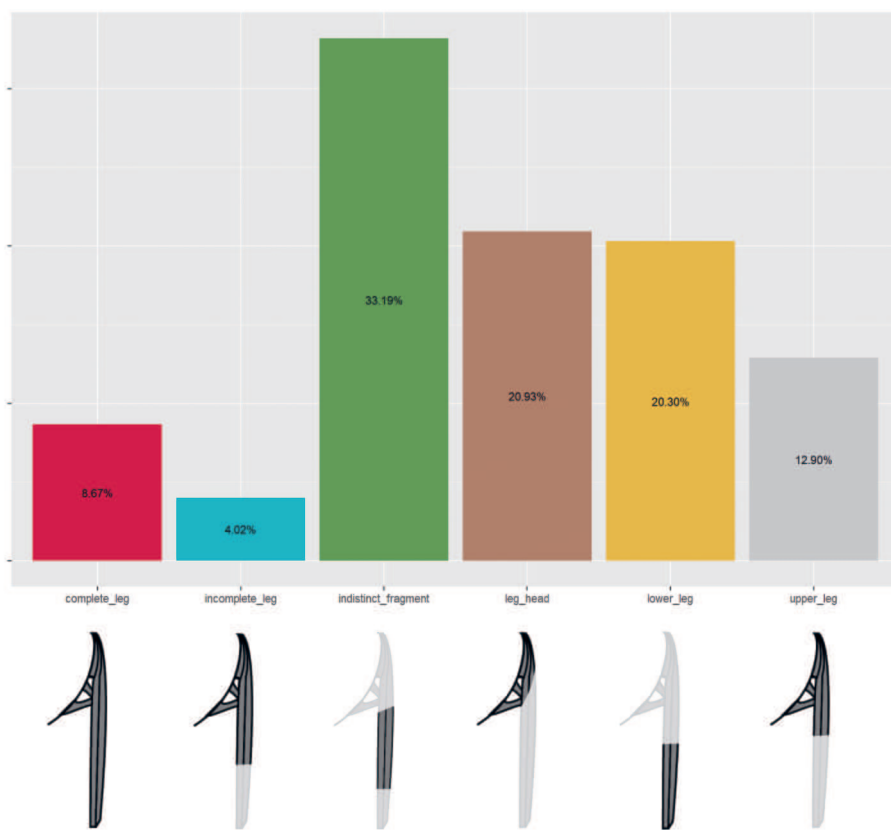


Fig. 14 Conservation index of tripod legs. – (Edited by A. Scarci from graphics by M. Ober, LEIZA, and Miningful srls).

sult raises the question whether each piece of tripod cauldrons is to be interpreted as *pars pro toto*, or if a selection process was rather conducted, whereby the most significant and representative parts of the object were secondarily dedicated to the deity, while the rest were intended as recasting products (Kyrieleis 2006, 95–102). Alternatively, it is possible that the preserved part was less important than the act of fragmentation itself, suggesting that any fragment, regardless of its type, functioned as a primary agent imbued with religious significance (Gaydarska 2024).

After assessing the conservation index, the number of breakages of handles and legs was calculated by type. The results indicate an increase in the number of breakages for both handles and legs, rising from a mean of two for Types 2–3 to approximately three for Types 4–5 (figs 15–16). This suggests that the Middle and Late Geometric types exhibit a higher degree of fragmentation. Analysis of the production techniques for these types reveals that the greater fragmentation observed in Types 4–5 can

be attributed to their construction: legs were made from three welded panels, and the handles featured open-work designs. These factors made the later types more vulnerable to destruction and damage in comparison with the more massive Types 2–3.

Descriptive Analysis

A Frequency Distribution Analysis (FDA) was conducted to visualise the distribution of handle and leg lengths and weights, aiming to identify clusters and recurring patterns. The data were grouped into value ranges (bins) to detect notable concentrations. Kernel Density Estimation (KDE) was applied to smooth the curve and facilitate the identification of peak values, following a previously validated method (Lago et al. 2023, 6–7). The results are presented as histograms, highlighting the peaks where the majority of values are distributed.

The FDA of lengths shows two right-skewed histograms, with most values clustered on the left side of

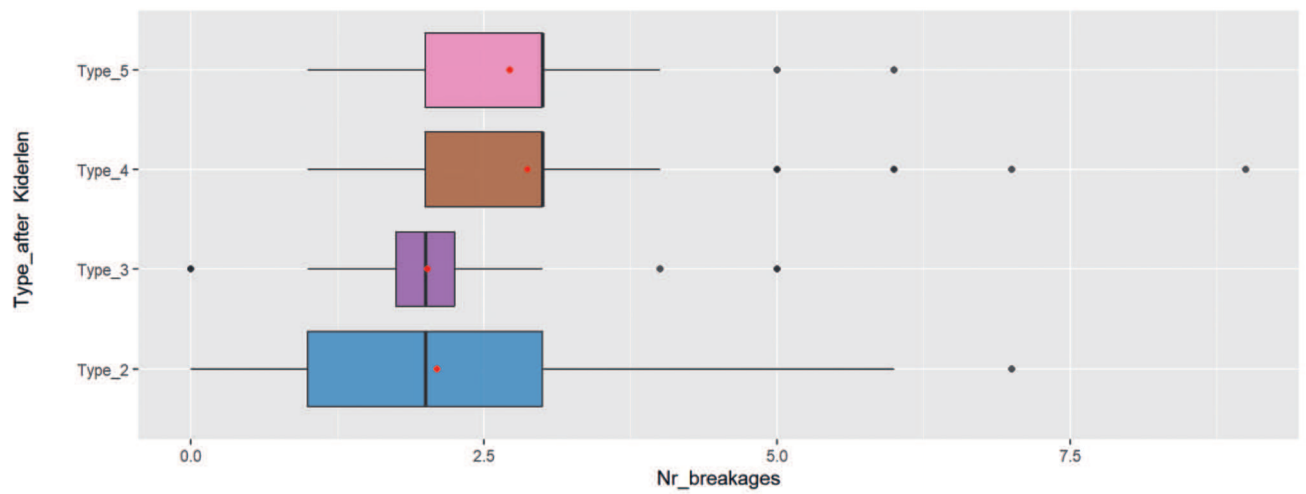


Fig. 15 Boxplot of the means of the number of handle breakages per type. – (Graphics Miningful srls).

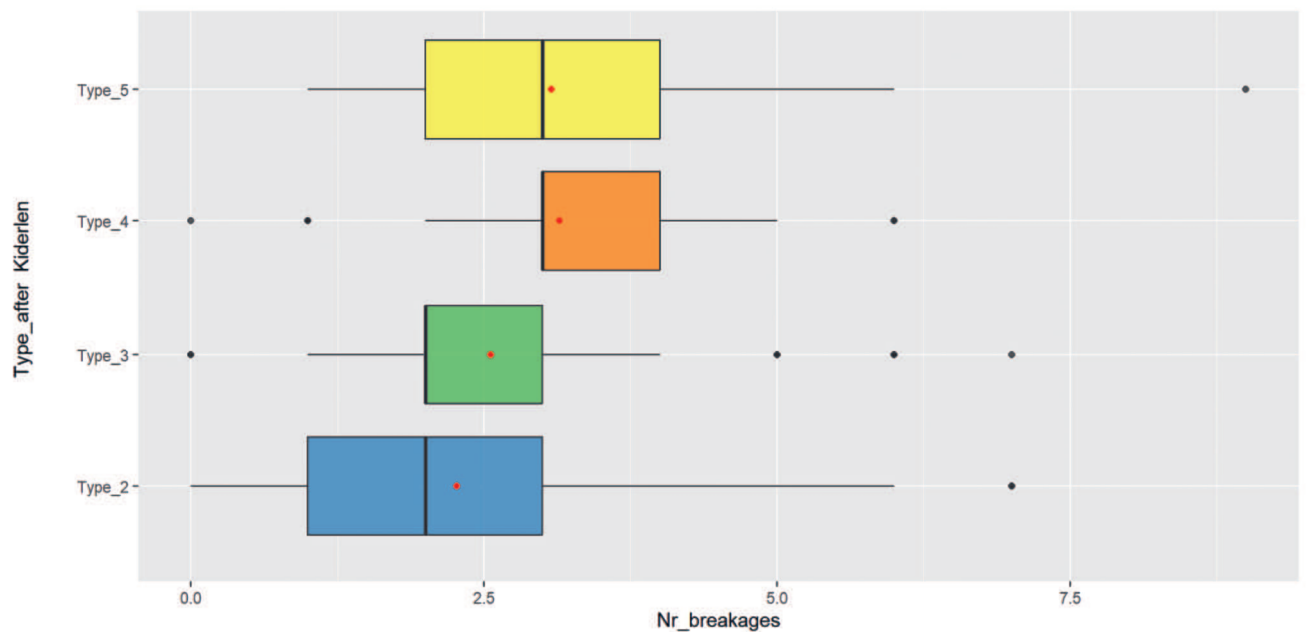


Fig. 16 Boxplot of the means of the number of leg breakages per type. – (Graphics Miningful srls).

the distribution. Handle lengths exhibit two primary peaks at 4–6 and 9–10 cm, with a weaker peak at 13–14 cm. In contrast, leg lengths demonstrate a broader distribution, with most values ranging between 3 and 20 cm, and a significant peak at 5–10 cm (figs 17–18).

Similarly, the FDA of weights reveals a right-skewed distribution, with most data concentrated on the left side. Handle weights are predominantly

clustered between 20 and 300 g, with a weaker peak observed between 800 g and 1 kg. Leg weights, on the other hand, fall mainly between 100 and 300 g (figs 19–20).

These results provide a more comprehensive understanding of the legs than was previously suggested by S. Bocher (2013, 357). Analysis of the clusters for both handles and legs shows a wider distribution

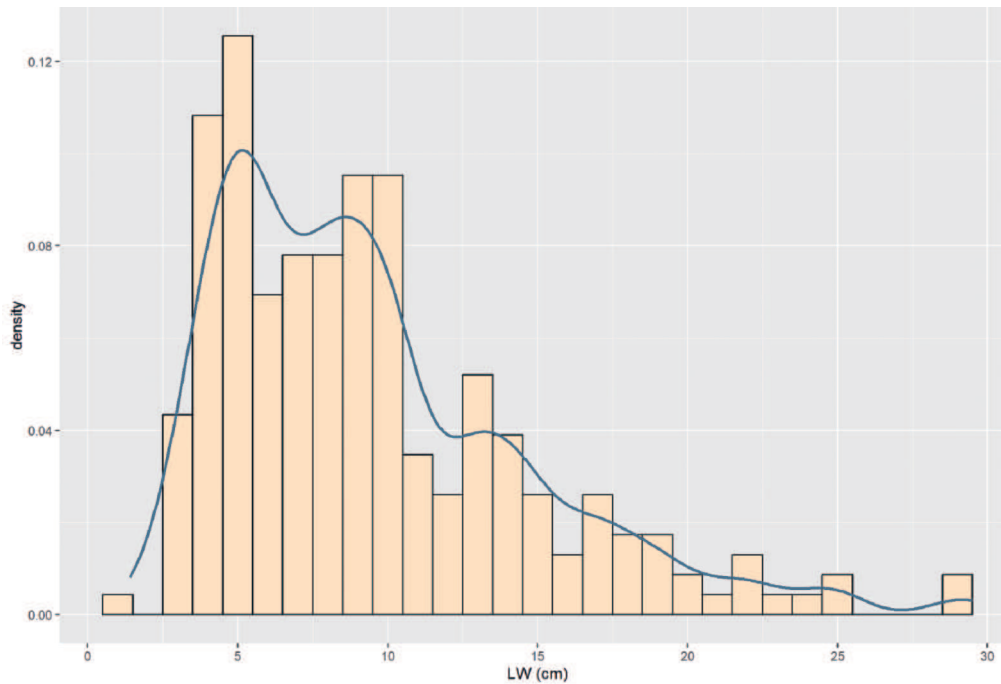


Fig. 17 The FDA of handle lengths. – (Graphics Miningful srls).

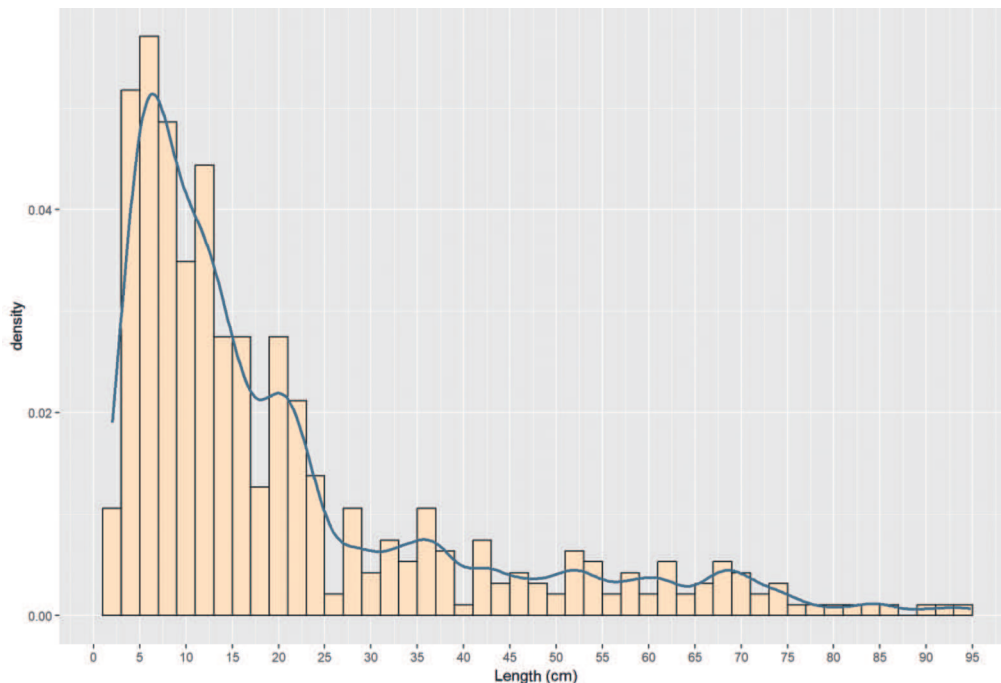


Fig. 18 The FDA of leg lengths. – (Graphics Miningful srls).

of values within a 10 cm range, unlike the previously suggested 10–20 cm leg range. The prevalence of small fragments supports both the *pars pro toto* hypothesis and the idea of deliberate, systematic fragmentation for recasting. The fragment lengths align with the dimensions of crucibles found at Olympia,

which have a maximum diameter of 40 cm (Baitinger 2021, 7 fig.3). However, the reason these fragments were not melted down remains unresolved.

The weight clusters identified for both handles and legs do not offer a definitive explanation for their significance or specific use. To explore the

Fig. 19 The FDA of handle weights. – (Graphics Miningful srls).

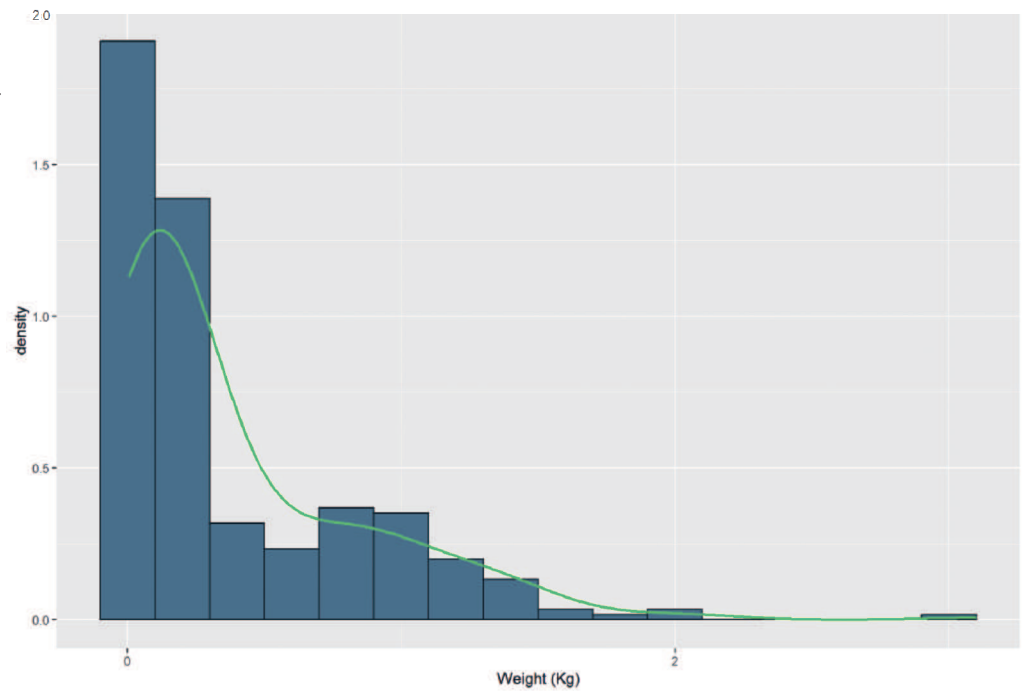
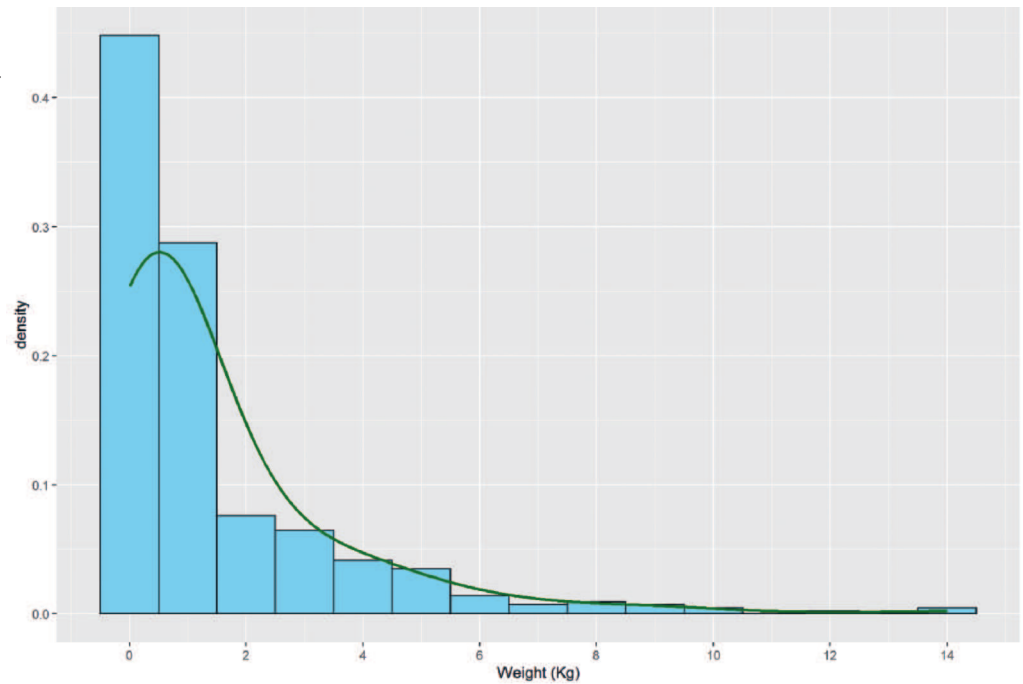


Fig. 20 The FDA of leg weights. – (Graphics Miningful srls).



possibility of underlying basic units, the FDA was completed by Cosine Quantogram Analysis (CQA) and a Monte Carlo test for statistical significance (Ialongo/Lago 2021; Hermann 2022; Lago et al. 2023; 2024). However, based on the available data, this analysis did not yield significant results, likely due to

the limited dataset (Lago et al. 2024, 230). It can be concluded that the tripod cauldron handles and legs were not deliberately fragmented with the intention of achieving specific weights within a standardised value system. Rather, it seems that the fragmentation was done in order to achieve specific lengths.

Sicilian-Italic Spearheads

The sanctuary of Olympia has yielded 49 bronze spearheads of Sicilian-Italic type, 12 of which are nearly intact, while 37 are in fragments (**fig. 21**). These spearheads closely parallel those discovered in hoards from central and southern Italy dating to 850–750 BCE. Of particular interest is a variant characterised by holes at the base of the blade, primarily found in Campania, Calabria and Sicily. These spearheads can exceed 60 cm in length, feature a short socket, a pronounced midrib, and two holes at the base of the blade, likely for decorative purposes. Their disproportionate length, short socket, unsharpened edges, heavy weight, and evidence of casting defects suggest they were non-functional weapons (Albanese Procelli 1993, 178. 180; Baitinger 2013, 219. 229).

The fragments from Olympia closely resemble those from these hoards in both typology and treatment, specifically in the fragmentation into variously sized pieces. These parallels have prompted scholarly debate regarding the identity of the worshippers who dedicated these objects and the reasons for their offerings at the sanctuary of Olympia and other Greek sanctuaries, such as Delphi (Aurigny 2016). Some scholars suggest that these spearheads were votive offerings from Greek »colonisers«, possibly spoils of war taken from the indigenous population (Hermann 1983, 289–290; Naso 2012, 318), or that they were offered directly by the natives of southern Italy (Peroni 1989, 540; Söldner 1994; Strøm 2000, 73–74). This hypothesis implies that the spearheads were dedicated as weapons. Another hypothesis pos-



Fig. 21 Some fragments of Sicilian-Italic spearheads from Olympia. – (Photo A. Scarci/G. Stawinoga).

its that the spearheads, already fragmented, were offered to Greek sanctuaries not as weapons but for their metal value (Baitinger 2016a, 256–259), though whether they were donated by Greeks or indigenous people remains unclear.

A metalwork wear analysis of the spearheads from Olympia, supported by statistical analysis, now provides new insights into these hypotheses, addressing a key research questions of this project. This is made possible through direct comparisons between the specimens from Olympia and those from the Mendolito hoard in Adrano (prov. Catania/IT), the largest hoard known in southern Italy, comprising approximately 900 kg of intact and fragmentary metal objects. Notably, the hoard contains 215 spearheads, including both two-hole and non-holed variants (Albanese Procelli 1993, 119–139). These similarities offer a basis for comparison and analysis with the spearheads from Olympia.

Results of the Metalwork Wear Analysis of the Spearheads from Olympia and Mendolito Hoard in Adrano

The metalwork wear analysis involved both microscopic and macroscopic examination of the 49 spearheads from Olympia. The results revealed recurring marks of destruction across small groups, but no consistent patterns in the destruction process. Five destruction indicators (DIs) (notches, blow marks, flattening, breakages, and indentations) were identified as recurring features on the cutting edges of the blades, though not always in combination. Similarly, two DIs (blow marks and flattening) were observed on the midribs, and two others (blow marks and breakages) on the sockets. Notably, blow marks appear near the breaking points, as well as along the cutting edges.

Of particular interest, two spearheads (B 4816 and B 4903) exhibit indentations that closely resemble saw blade marks (Baitinger 2013, 223 figs 102–103; Scarci 2024, 18 fig. 6) (**fig. 22**).



Fig. 22 Indentation on the spearhead B 4903 from Olympia. – (After Scarci 2024, fig. 6). – Scale 2:3.

Following the analysis of the spearheads from Olympia, a comparable metalwork wear analysis was conducted on 173 spearheads from the Mendolito hoard (currently housed in the Archaeological Museum of Syracuse). This analysis used the same set of DIs for Olympia to highlight both similarities and differences between the two datasets.

A more detailed summary of these findings, including EDA and descriptive analysis, is presented in the subsequent section.

Results of the Statistical Analyses of Spearheads from Olympia and the Mendolito Hoard in Adrano and Their Archaeological Interpretation

Despite the differences in the number of objects between the two datasets, several significant observations emerge from their comparison. The data reveal a lower frequency of DIs on the blade cutting edges of spearheads from the Mendolito hoard compared to those from Olympia. Notches, which are highly prevalent at Olympia (44 %), and breakages are notably rare in the Mendolito hoard (**fig. 23**). DIs on the socket and midrib are also less frequent in both datasets. Over 60 % of the spearheads from Olympia show blunt cutting edges, with minimal evidence of blow marks at the breaking points, though blow marks

can sometimes be observed near the breakages (Scarci 2024, fig. 8). A similar pattern is observed in the Mendolito spearheads, consistent with experimental archaeological findings suggesting that destructive processes occurring at temperatures of c. 500–600°C leave no evidence of marks at the breaking points (Knight 2022, 23–24). Notably, almost 50 % of the Mendolito spearheads have bent ends, a feature rarely observed at Olympia.

The blunting of the cutting edges reinforces the idea that these spearheads were not used in battle, while the severe damage observed on the cutting edges of the Olympia spearheads likely cannot be attributed to combat either. These results support the hypothesis put forward by R. M. Albanese Procelli and H. Baitinger, which suggests that Sicilian-Italic spearheads served a symbolic rather than functional role.

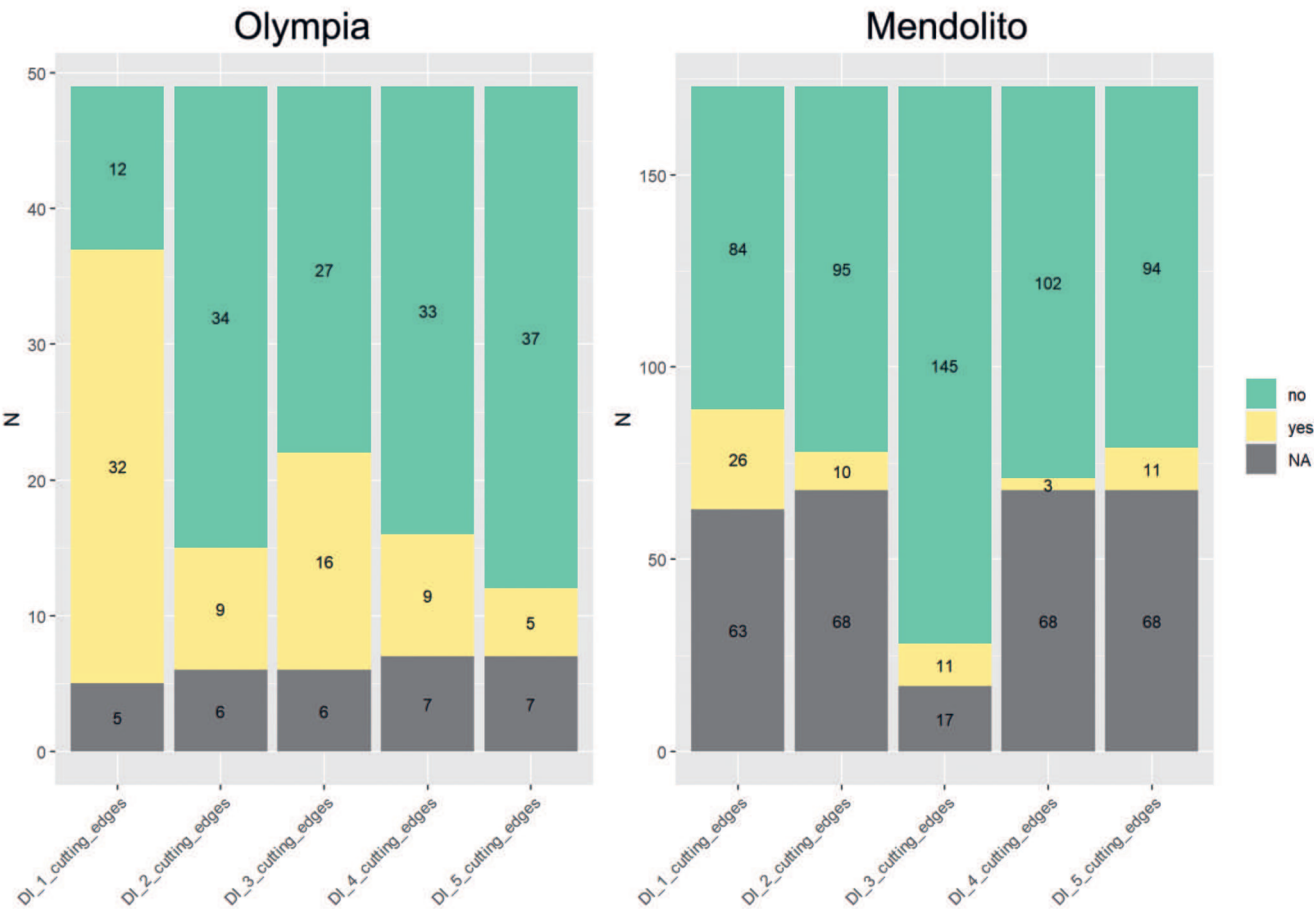


Fig. 23 Frequency of destruction indicators on spearhead cutting edges from Olympia and the Mendolito hoard. – (Graphics Miningful srls).

To acquire deeper insights into the key research question, the conservation index was calculated for the spearheads from Olympia and Mendolito. While the upper blade fragments are the best preserved parts in both datasets, the overall conservation index varies significantly between them, emphasising similarities and differences (fig. 24).

Subsequently, a FDA, supplemented with KDE, was performed on the lengths and weights of both datasets to identify potential clusters. Despite the heterogeneity of the two datasets, several recurring patterns and variations in the distribution of lengths and weights were observed. As with the tripod handles and legs, the FDA results produced right-skewed histograms, with most data clustered on the left. The distribution of fragment lengths at Olympia shows three peaks at approximately 6–7 cm, 15 cm, and 30 cm, while the Mendolito dataset shows two main peaks at 5–7 cm and around 60 cm, the latter representing a cluster of complete spearheads (fig. 25). Both datasets share a cluster of small fragments (5–7 cm), though only at Olympia is a cluster of fragments between 25 and 33 cm.

The weight distributions in both datasets show several peaks, with most values concentrated between 0 and 50 g (fig. 26). Interestingly, there is a gap in the Olympia dataset between 50 and 75 g, a range represented in the Mendolito dataset. Above 200 g, the distribution diverges, likely influenced by the limited number of pieces available from Olympia. The use of CQA with FDA did not yield significant results, likely because of the limited dataset size. These statistical analyses provide valuable insights into whether the Sicilian-Italic spearheads were brought to Olympia as intact or fragmented votive offerings. The evidence suggests that smaller fragments probably arrived broken, valued for their material rather than as weapons. Probably intact upon arrival, the longer pieces were later destroyed in an »Olympian« manner, not a »Sicilian way« (Hansen 2016, 196), as evidenced by breakages, notches and indentations on the cutting edges. The presence of matching fragments, accounting for 20.4 % of the group, suggests that at least one batch of intact spearheads was brought to Olympia before being deliberately destroyed. This destruction followed both

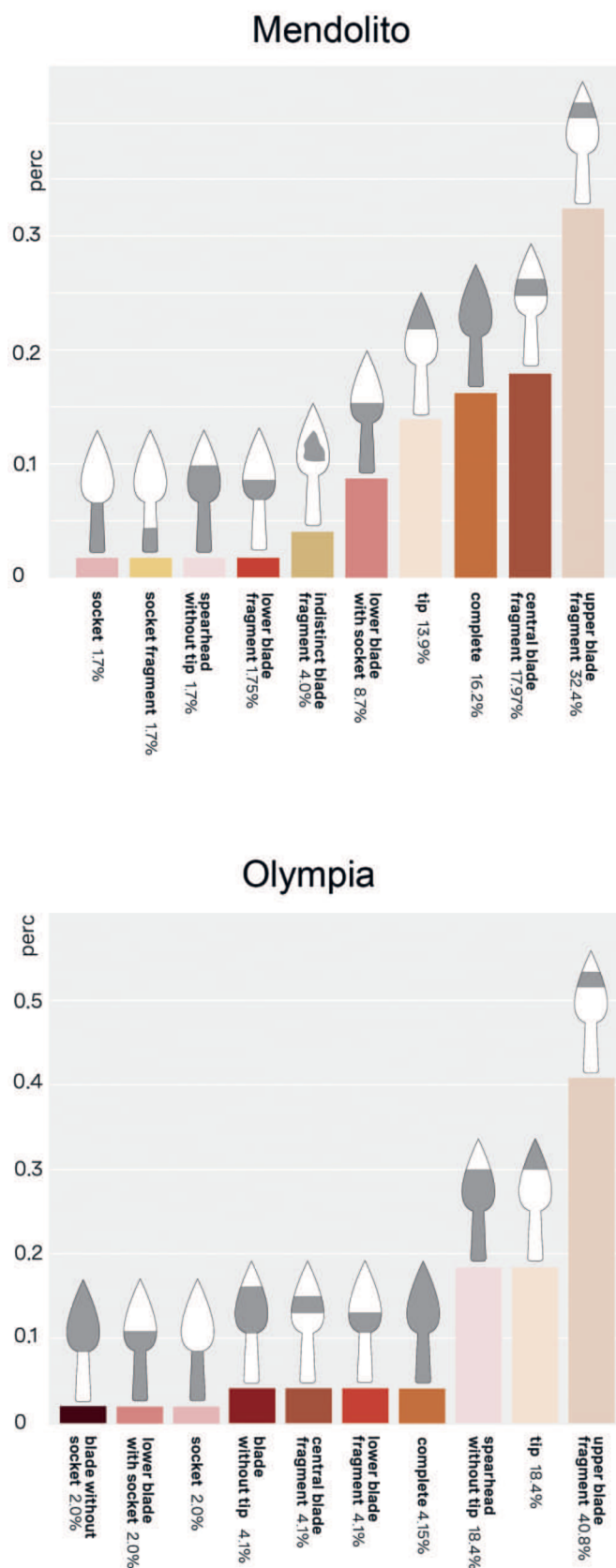


Fig. 24 Conservation index of spearheads from Olympia and the Mendolito hoard. – (Graphics M. Ober, LEIZA).

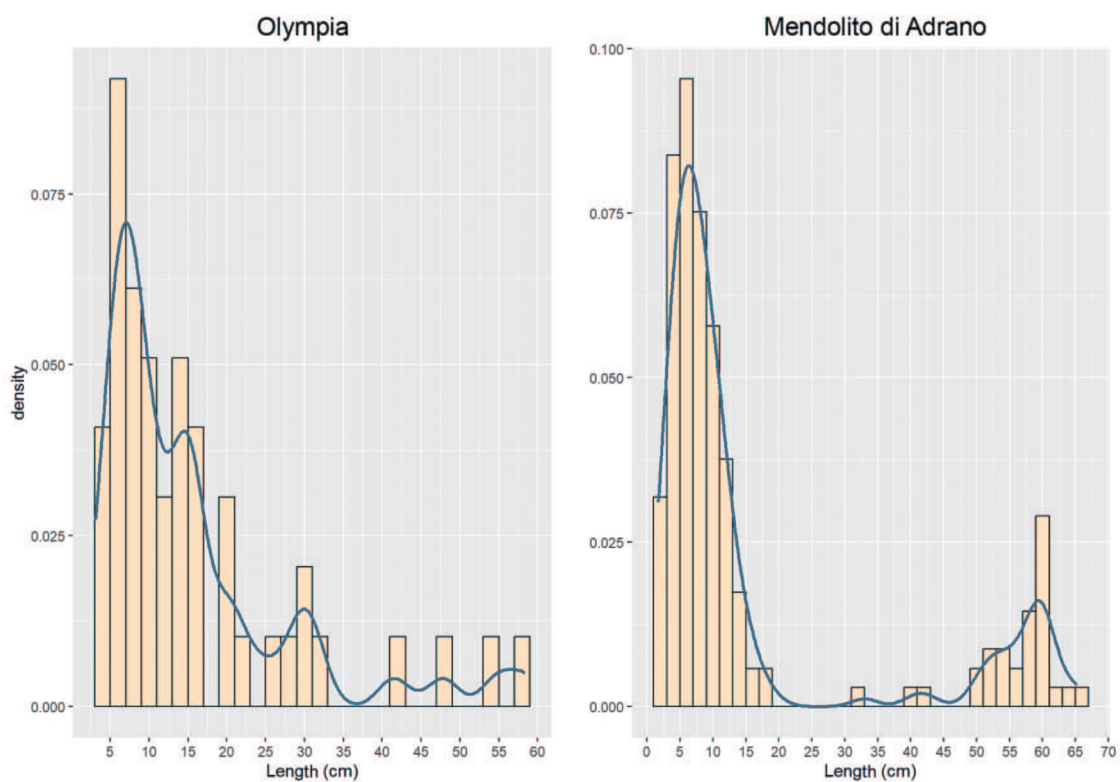


Fig. 25 The FDA of spearhead lengths from Olympia and the Mendolito hoard. – (Graphics Miningful srls).

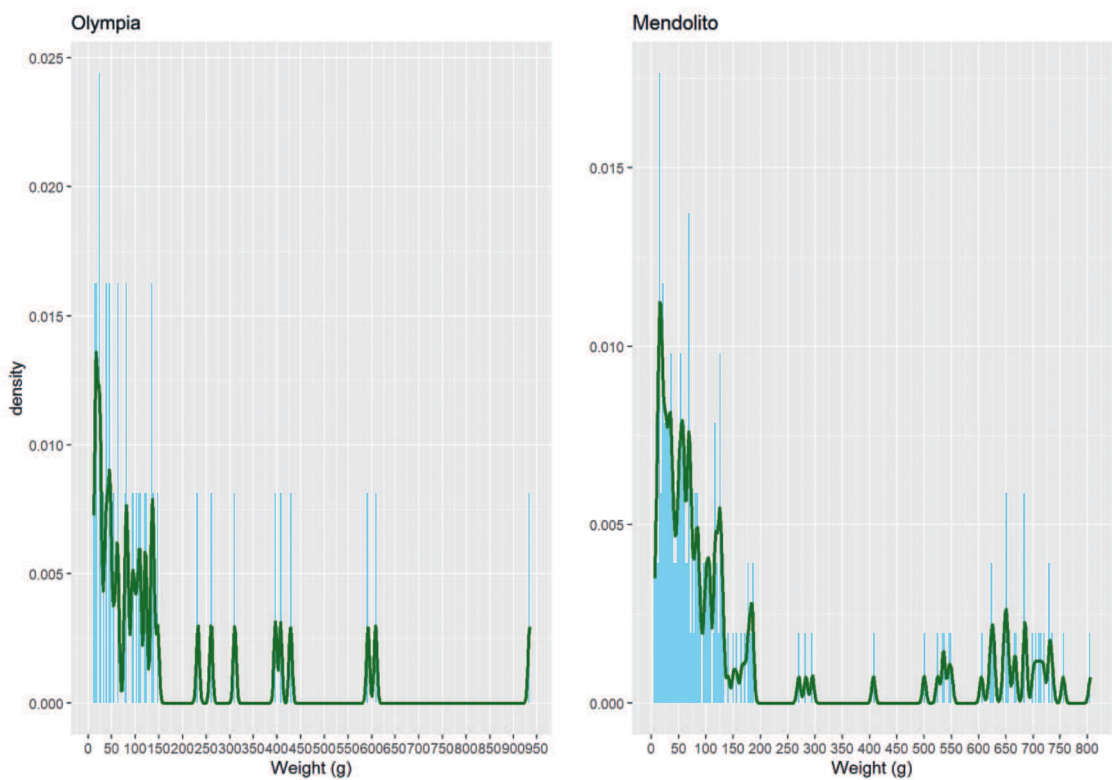


Fig. 26 The FDA of spearhead weights from Olympia and the Mendolito hoard. – (Graphics Miningful srls).

an »Olympian« manner, by damaging the cutting edges, and a »Sicilian« one, by breaking the blade into several pieces. Notably, unlike in the Mendolito and other hoards, where bent ends are common, no such feature is present in the Olympia fragments.

Fragmentation as Ritual Practice? Some Final Remarks

The combination of metalwork wear analysis and statistical methods opens new insights into the phenomenon of fragmentation at the sanctuary of Zeus at Olympia. The dismantling and fragmentation of tripod cauldrons, along with the destruction of Sicilian-Italic spearheads, appear to be deliberate and systematic processes, though these actions remain open to multiple interpretations.

With tripod cauldrons, the dismantling seems to have been performed by skilled metalworkers, who, familiar with the objects' structural weaknesses, targeted specific points to achieve their objectives efficiently, minimising time and effort. However, the motivations behind this dismantling and fragmentation are less clear. In some cases, after systematic dismantling, the legs and handles were not further fragmented, as evidenced by the discovery of intact specimens, some of which were found in the wells of the stadium or the southeast area. This act, which could be interpreted as profane, may have been intended to free the sanctuary from the overcrowding of votive offerings during the early Archaic period. The random deposition of offerings in the wells, where pieces from different tripods were seldom found together, suggests that this was a means of creating a space within the sanctuary.

With a small group of handles recovered intact, it was observed that the strap was rolled up at the point of dismantling (fig. 27). This could suggest a ritual act of further manipulation.

In most instances, the dismantling of the tripods was followed by fragmentation into small pieces, which may have had multiple interpretations. On one hand, this could be seen as a profane act intended to prepare the metal for re-melting. On the oth-

Matching fragments in hoards are generally rare (Lago 2020, fig. 5), with the Mendolito hoard being an exception, containing 10 matching fragments out of 215 spearheads.

er hand, it might represent a votive practice of *pars pro toto*, a symbolic gesture of partial preservation of the dedication, similar to the *ouk ekphora* practice (Kilian-Dirlmeier 2002, 193). This sacred law, documented from the Classical period onwards, stated that a votive offering became the property of the deity and could not be removed from the designated area, the *temenos*.

As Bocher (2013, 357) suggests, a combination of both the profane and ritual hypotheses should not be rejected. It is plausible that a single fragment of a tripod cauldron was dedicated as *pars pro toto*, while the remaining parts were re-purposed to create new objects for the sanctuary. Bocher's examination of matching fragments tested this hypothesis. For cast tripod cauldrons, typically only one or two matching fragments are found per object, whereas hammered tripod cauldrons can yield up to 20 matching fragments (Bocher 2013, 357–358 fig. 3). This has been interpreted as evidence that cast tripod cauldrons, being more valuable, were dismantled and their metal recycled, removing them from circulation. The discovery of approximately 800 kg of cast tripod fragments at Olympia, some belonging to the same tripod cauldron, raises questions about why such a significant quantity of unused metal was left in the sanctuary. A third hypothesis that may help explain this accumulation is that the sanctuary, like others, functioned as an institution for the »accumulation and potential redistribution of wealth« during the EIA and Archaic period. This suggests that the tripod fragments were part of »a process of commodity alienation that in a ceremonial way placed wealth at the disposal of the community« (Gimatzidis 2021, 173–178). Both in their intact form and fragmented



Fig. 27 Two tripod handles from Olympia (Br 8242 and B 166) with inwards rolled straps. – (Photo A. Scarci).

state, the tripods demonstrate the enduring value of these offerings over time.

Further contributions to the interpretation of fragmentation are being developed through contextual and spatial analysis in a GIS environment. This analysis focuses on the distribution of fragments across all material categories selected for study, aiming to identify distribution patterns and potential associations with functional areas within the sanctuary, such as metal workshops, altars, and temples.

Regarding the spearheads, the results do not provide a definitive answer whether they were brought to Olympia by Greeks or indigenous peoples from southern Italy. However, the findings offer a clearer understanding of how the spearheads arrived, both intact and fragmented, thus reopening the scholarly debate on the significance of these votive offerings. Further support for the hypothesis that Sicilian-Italic objects arrived at Olympia both intact and fragmented, comes from the Sicilian ring-handle

cauldrons. These are represented at Olympia by an almost intact specimen (see **fig. 5**), the only one ever found in such a well-preserved state in the Mediterranean, as well as by individual handles or handle fragments that have exact parallels in IA hoards from Sicily (Baitinger 2013, 242–251).

The extensive damage observed on the blade cutting edges of some spearheads from Olympia does not correspond to the patterns seen in the Mendolito hoard or other Late Bronze Age and IA Sicilian hoards, such as Giarratana (prov. Ragusa/IT; Albanese Procelli 1993, 63–65), Castelluccio (prov. Ragusa/IT; Di Stefano/Giardino 1990–1991, 507–509), or Polizzello (prov. Caltanissetta/IT; Palermo 1981, 123). This suggests that these objects may have been

treated at Olympia to remove them from their original role as weapons or symbols of power. It remains unclear whether this treatment occurred before dedication, just prior to deposition, or before disposal. The presence of ten matching fragments at Olympia further supports the idea of fragmentation practices that resemble Sicilian-Italic traditions from the IA, in contrast to the relatively few instances of deliberate fragmentation in Greek hoards (Blackwell 2018; Kleitsas et al. 2018).

The results thus far indicate that the fragmentation of bronze votive offerings at Olympia is a complex and multifaceted phenomenon, requiring nuanced interpretations and caution against oversimplified categorisations.

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Fragmentation and Use-Wear Analysis

Use and Abuse in Later Bronze Age Metalwork Hoards from Britain

ABSTRACT

Later Bronze Age metalwork is found in various conditions, ranging from freshly cast to heavily used and fragmented. Even within a single hoard we may find brand new objects alongside deliberately broken ones. These different states tell a variety of stories about the roles of different objects and their relationships with people as well as how hoards were formed before they were placed in the ground. Recent approaches to understanding wear on objects are refining our interpretations for the use and destruction of Bronze Age metalwork, particularly through experimental archaeology. Through case studies from Britain, this paper will explore the variety of ways objects were used (and occasionally abused!) and what this can tell us about the meaning of hoards at this time.

KEYWORDS

Bronze Age | metalwork | fragmentation | use | hoards

The Corrymuckloch Hoard

In 1995, a small Late Bronze Age hoard was found during peat extraction at Corrymuckloch (Perth and Kinross/GB) (**fig. 1**; Cowie et al. 1996). This hoard contained three complete socketed axeheads, three refitting fragments of an incomplete sword and a unique decorated vessel. Subsequent excavation failed to identify any context. The socketed axeheads are of three different regional types and were well-cast with each showing signs of similar asymmetric wear at the cutting edge – these were perhaps used as part of the same activity. They would have been functional objects when buried. By contrast, the sword in three pieces was deliberately fragmented, with pieces missing, and it is bent along its length. The tip is bent and cracked, the edges have been hammered and one edge is bowed, but none of this is conclusively use-related. One might suggest that this is a hoard of used or abandoned material – a common interpretation drawing upon 19th-century functionalist approaches (e. g. Evans 1881) – but the axeheads would have still been usable and the sword pieces are too large for a crucible. Additionally, the vessel is,

so far, completely unique in Europe and beautifully ornamented (Cowie et al. 1996), an undoubtedly special object. It is hard to recognise signs of wear on the vessel, but it may have been used for feasting or drinking. The varied states of these objects encourage us to consider the varied uses and treatments of different objects and their relationships with people, as well as how hoards were formed before they were placed in the ground. The axeheads may have been part of a toolkit, the sword was perhaps decommissioned following conflict, and the vessel might have been an imported or locally manufactured elite item. The reasons these objects were brought together are unclear, but this hoard emphasises that a straightforward interpretation is unlikely to be satisfactory. These objects were seemingly selected to be deposited together, and their wear conditions were likely part of this.

In part we are able to make such interpretations with more confidence due to developments in wear analysis and experimental archaeology; this is crucial as later Bronze Age metalwork is found in vari-



Fig. 1 The Corrymuckloch hoard (Perth and Kinross/GB). – (© National Museums Scotland).

Fig. 2 Map of key sites mentioned in text. – (Contains OS data © Crown copyright and database right 2024).



ous conditions and contexts across Europe, ranging from freshly cast to heavily used and fragmented, a mixture of use and abuse enacted on objects. In this paper, I will give an overview of recent developments in wear analysis and present case studies of metalwork hoards from Britain dating from the

Middle and Late Bronze Age and the Earliest Iron Age (Bz C1–Ha C) (c. 1500–600 BC) (**fig. 2**). These will highlight the integrated relationships between the treatment and deposition of the objects and the people who owned them.

Wear Analysis

Use

Recent years have seen an explosion of studies analysing wear on objects, particularly integrating experimental archaeology, and resulting in a field of

research that continues to develop (Dolfini/Crelin 2016). Earlier studies highlighted obvious signs of wear on objects, occasionally coupled with basic laboratory tests, to quantify and emphasise the nature of wear seen on prehistoric metal objects

(e. g. Kristiansen 1978; Taylor 1993; Bridgford 2000; Turner 2010). However, seminal experiments involving copper and bronze axeheads (Kienlin/Ottaway 1998; Roberts/Ottaway 2003) paved the way for an ever-expanding field of experiments involving bronze objects. Notably, B. Molloy (2006 *inter alia*), with his background in martial arts, conducted highly influential experiments involving rapiers, swords, spears and shields that redefined how we conceptualised the use of these objects. Thin-bladed rapiers proved to be effective thrusting weapons, and copper and bronze shields were demonstrated as capable defensive equipment. Many subsequent studies have combined experimental archaeology with wear analysis to better interpret a range of features seen on objects, such as notches, nicks, bowing and bending (e. g. O’Flaherty 2007; Horn 2013; 2014; Horn/von Holstein 2017; Uckelmann/Mödlinger 2011; Gentile/van Gijn 2019).

The most comprehensive published work of this nature is the project »Bronze Age Combat« (Hermann et al. 2020a; 2020b). This project utilised a range of replica swords and spears as well as leather, wooden and bronze shields which were tested by combatants using controlled motions, as well as »actualistic weapon tests«, which explored combat through continuous combat actions. These produced a range of wear marks that could be linked with specific motions and were recorded in detail for com-

parison with archaeological artefacts. The results of the experiments were published with extensive photographic details to assist researchers better understand wear marks, which should allow us to start to match wear analysis to specific combat motions and reveal how people engaged in combat.

This selective review of wear experiments highlights the currently dynamic field that is influencing how we understand the use of Bronze Age artefacts, though much of this work remains focused on weaponry with more needed on Bronze Age tools (this field is, however, growing, e. g. Gutiérrez Sáez/Martín Lerma 2015; Dolfini et al. 2023).

Abuse

Forms of damage and destruction have long been noted on metalwork occasionally forming the focus of research (e. g. Needham 1990; Quilliec 2008; Horn 2011), but understanding how this damage was sustained has been poorly studied. By contrast with use-experiments, destruction experiments are very limited and largely unpublished though represent an exciting emerging field. Understanding how bronze metalwork was broken can reveal to us prehistoric processes that can help us understand necessary skills or related activities that shape our interpretations. Experiments with bronze swords,

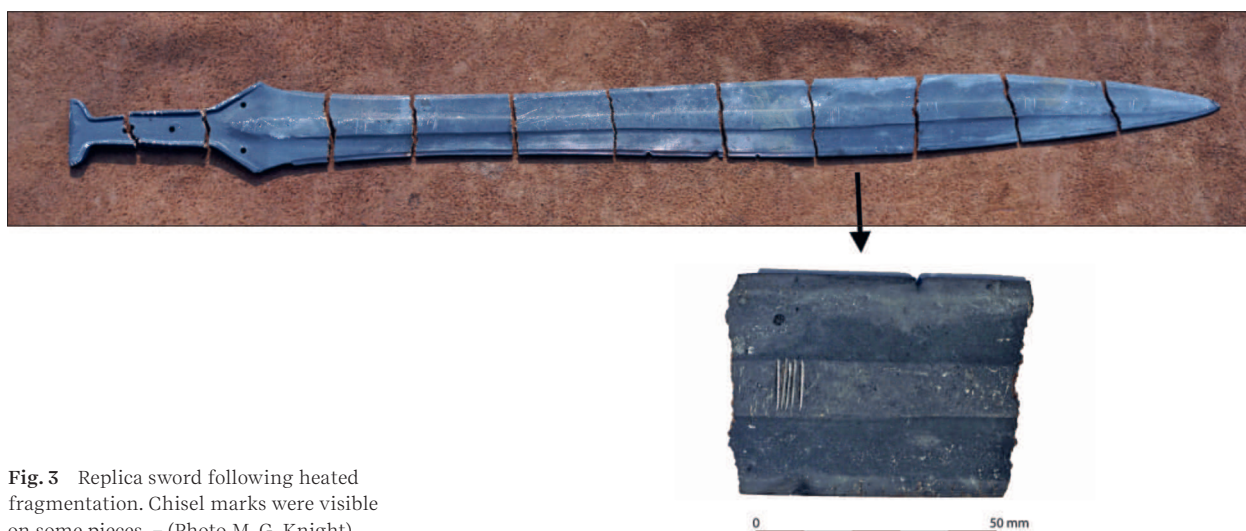


Fig. 3 Replica sword following heated fragmentation. Chisel marks were visible on some pieces. – (Photo M. G. Knight).

spearheads, axeheads and sickles illustrate that deformation and fragmentation are achievable with relative ease through heating and striking the objects (Knight 2017; 2019; Lago et al. 2023). This is, in part, a result of the material properties of the bronze metal, such as whether the alloy has lead inclusions, and material knowledge can affect what can be achieved (Giardino/Verly 2013; Knight 2019). It suggests that a metalworker would have been involved in fragmentation events with certain skills or equipment. A key observation from the experiments was that fragmenting metalwork left quite distinctive »clean« sharp breaks but did not always leave associated marks such as hammer or chisel blows (**fig. 3**). This opened the possibility that many more artefacts might have been deliberately fragmented than previously thought; a study of material from south-west Britain was able to quantify a substantial amount (Knight 2022a). Lago et al.'s (2023) experiments furthered this by exploring the fragmentation of sickles in relation to metrology and finding that even seemingly random fragmentation might fit within a weight-based system; skilled fragmentation would improve the accuracy of pieces with desired weights.

Use and Abuse over Time

We may now turn to the archaeological evidence. Whilst it is widely recognised that there is a general increase in the level of wear on metal objects from the Early to Late Bronze Age, there are surprisingly few studies that demonstrate this temporal trend. R. Taylor (1993) assessed Bronze Age hoards from southern Britain and applied statistical analyses to determine any correlation between objects, wear and completeness. He highlighted regional and temporal variations where, at particular times, there was a high level of significance between wear on objects and completeness. For instance, during the Taunton metalworking assemblage (1400–1250 BC), ornaments more often showed signs of wear than weapons or tools, which were more often complete or showed less wear. He also highlighted that weapons were more often buried broken in the Ewart

However, comparisons of the experimental data with the archaeological record remains largely macroscopic and observational, and thus open to interpretation (Knight 2021). The challenges of this are emphasised where metallography has been undertaken on fragmented artefacts. Metallographic analysis of a hoard of broken weapons from Waterden (Norfolk/GB) some with macroscopic signs of burning, showed that while some were broken hot, others were broken while cold (Bridgford/Northover 2020, 65). Similarly, M. L. Perez Gonzalez and R. Schwab (2023) undertook metallographic study of eight sword fragments and a dagger fragment from a large fragment-dominant hoard from Slavonski Brod (Brod-Posavina County/HR). This revealed that all but one of the fragments was probably broken at room temperature, that is without any additional heating, despite appearing macroscopically similar to those broken at high temperatures (Perez Gonzalez/Schwab 2023). In seeking to understand fragmentation practices and the people who undertook this, we clearly need to be developing destruction experiments on the scale of use experiments in conjunction with microstructural analysis.

Park metalworking assemblage (Ha B2, 920–800 BC). This approach failed to appreciate the deliberate destruction of objects though, and lacked experimental archaeological approaches to wear analysis that would support the interpretations. Other studies have highlighted extensive fragmentation as well as correlations between the extent of wear and the level of destruction (e.g. Needham 1990; Maraszek 2006; Turner 2010), but these have generally been concerned with a specific time period, usually the Late Bronze Age.

In Britain, the first study to assess the relationship between use and damage over time was York's (2002) investigation of Bronze Age metalwork recovered from the River Thames. J. York assessed 302 objects, largely Middle–Late Bronze Age weaponry (spearheads, swords, dirks and rapiers), recovered

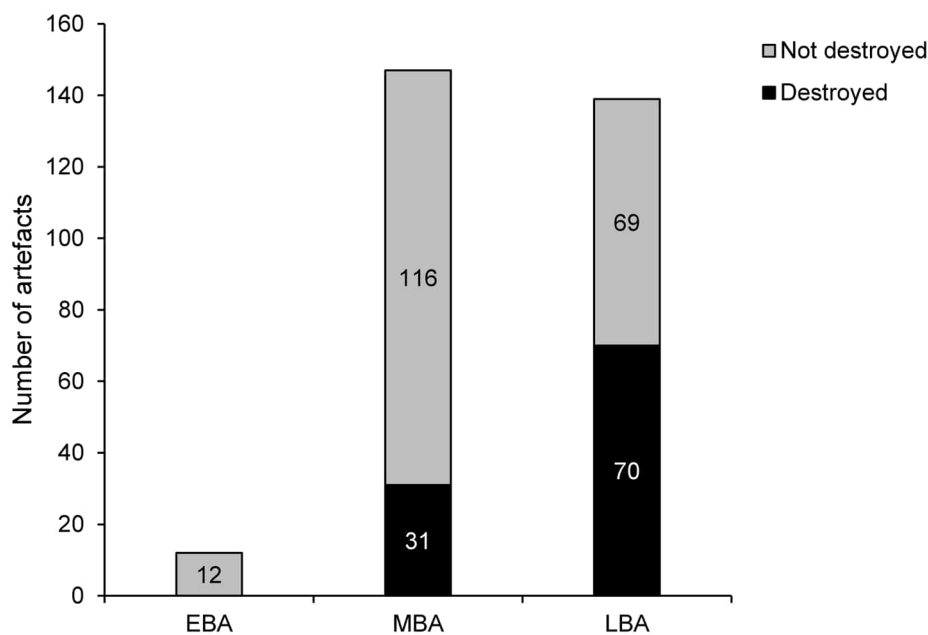


Fig. 4 A comparison of metalwork classed as »destroyed« or »not destroyed« from the River Thames. – EBA = Early Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age. – (Data from York 2002; graphics M. G. Knight).

Damage ranking	Description	Criteria
0	not deliberate	evidence of corrosion and post-depositional processes or casting flaws that would have caused damage
1	probably not deliberate	damage combined with use-wear or consistent with unintentional damage
2	probably deliberate	no associated marks but consistent with damage one would expect from intentional practices informed by experiments
3	deliberate	damage that could only have been sustained intentionally, typically with associated marks
n/a	not applicable	complete objects
uncertain	uncertain	objects displaying several features that cannot be conclusively determined

Tab. 1 A summary of the Damage Ranking System and key criteria. – (After Knight 2022a, 26–35).

from the upper Thames river and its tributaries and recorded whether objects were »used« or »unused«, »destroyed« or »not destroyed«.

About 50 % showed signs of use but were not destroyed, while around a third showed signs of destruction, whether used or unused. York’s results also highlighted that evidence for the destruction of objects (such as fragmentation, burning and bending) clearly increased over time. No Early Bronze Age objects showed signs of destruction, while about 21 % were destroyed in the Middle Bronze Age and 50 % in the Late Bronze Age (**fig. 4**), though proportions relating to individual objects are higher. A greater proportion of spearheads and swords were destroyed, for

instance, whereas axeheads were less likely to show signs of destruction (a similar conclusion to Taylor 1993). Subsequent work in Britain and Europe has also highlighted higher proportions of deliberately damaged weaponry associated with rivers and other watery locations (e. g. Mörtz 2018).

Metalwork from south-west Britain similarly highlighted that people more often undertook deliberate destruction and deposition over time, including all object types from all contexts (Knight 2022a). Building on experimental work, a »Damage Ranking System« was applied that ranked damage by the probability that it was deliberate with 0 being definitely not deliberate and 3 being definitely de-

Fig. 5 Proportions of object completeness within each chronological period from south-west Britain (n = 1550). – EstIA = Earliest Iron Age; for further abbreviations see **fig. 4**. – (After Knight 2022, fig. 2.23).

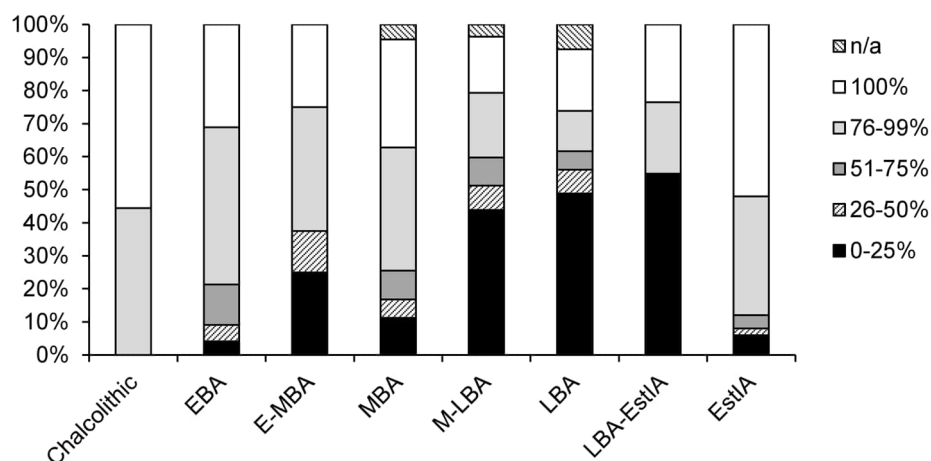
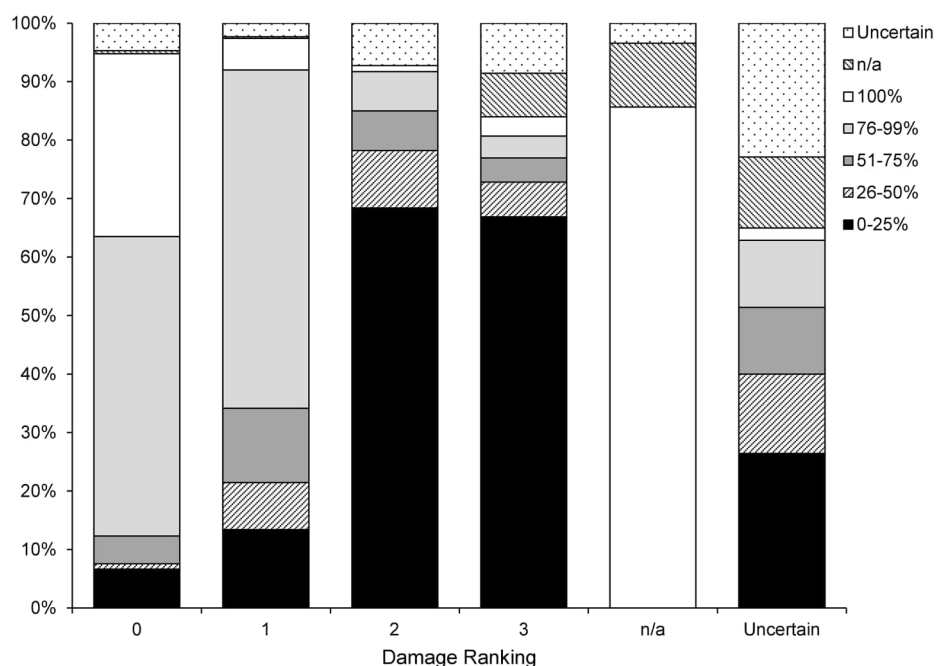


Fig. 6 Relative proportions of completeness of objects recorded within each Damage Ranking from south-west Britain (n = 1735). – (After Knight 2022, fig. 2.25).



liberate (**tab. 1**). The level of completeness was also recorded as well as signs of preparation and use of objects (Knight 2021; 2022a, 15–44). This allowed damage and completeness to be quantified over a range of objects and contexts.

Over time, more objects were deposited incomplete, particularly in the Late Bronze Age, though this drastically changed in the Earliest Iron Age (**fig. 5**). Analysis of the correlation of completeness with the Damage Ranking System highlighted that the smaller the object fragment (0–25 %), the more probable that the objects displayed signs of deliberate damage, irrespective of chronology (**fig. 6**). Conversely, the more complete (76–99 % / 100 %) objects

presented fewer signs of deliberate damage. Establishing this correlation between signs of deliberate damage and completeness means that when we introduce chronology in relation to the Damage Ranking System, we also have a basic understanding of the level of completeness; **figure 7** shows that evidence for deliberate destruction increases in the Middle to Late Bronze Age in south-west Britain and we also know that these are the periods with the greatest number of fragments. The Chalcolithic and Early Bronze Age and even into the Middle Bronze Age are periods where evidence for deliberate destruction is far less, and the same for the Earliest Iron Age. This was true across all contexts from south-west Britain,

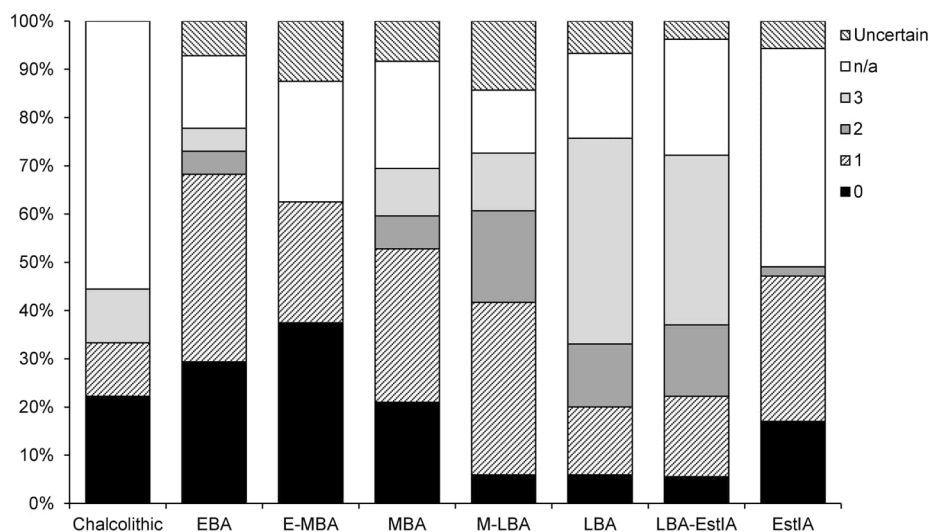


Fig. 7 Proportions of metal objects within each Damage Ranking from south-west Britain across the Bronze Age (n = 1655). – For abbreviations see **figs 4–5**. – (After Knight 2022, fig. 2.26).

including those from settlement sites, burials, single finds and hoards (Knight 2022a).

There were also trends in the types of objects that were fragmented. Ornaments and weapons, including pins, bracelets, rapiers and spearheads, were more often damaged in Middle Bronze Age hoards and single finds – a picture reflected across southern Britain (Taylor 1993; Wilkin 2017). Single finds and hoards of flanged axeheads, palstaves and other tools were almost always deposited complete or else accidentally broken. Tool-only hoards frequently comprised exclusively palstaves and these were almost always complete and occasionally as-cast when deposited though often showing some signs of post-casting preparation and minimal use, but no signs of destruction (Knight 2022a, 81–83). They might often have some form of arrangement in the ground, e.g. stacked or contained in a pit (Knight 2022a, 81–82).

Mixed hoards, containing a combination of either ornaments and tools, ornaments and weapons, or ornaments, tools and weapons, showed more variability but ornaments were more likely to show signs of wear and the worn ornaments are also deformed or fragmented in some way (Wilkin 2017). The same goes for weapons (Knight 2022a, 78–81). Tools might show signs of preparation or use but were generally the most complete objects. At Edington Burtle

(Somerset/GB), 18 tools and ornaments, including four used palstaves, four sickles, some used, some as-cast, and eight worn ornaments, were buried in a wooden box in a marshy area or bog (Stradling 1854; Smith 1959, GB.44; **fig. 8**). The tools were almost all complete, but the terminals were missing from a bar-twisted torc and another bracelet was missing one terminal; a further bracelet was threaded with two interlinked rings, one of which was produced from a fragmented torc terminal. The fragmentation of terminals was perhaps deliberate. The focus of damage on ornaments and weapons – objects that one might consider »personal« – may be a reflection of the connections between individuals and these object forms (Knight 2024), which required particular destructive treatments

By contrast, fewer ornaments were deposited during the Late Bronze Age, though bronze and gold bracelets, rings and pins were typically complete where deposited; axeheads, spearheads and swords, as well as ingots, were very fragmentary and regularly showed signs of deliberate damage. This is seen elsewhere in southern England and Wales (Gwilt 2004; Turner 2010).

The Earliest Iron Age (Ha C) hoards frequently contained complete, as-cast or accidentally broken axeheads. This general picture through time is reflected across southern Britain though with region-



Fig. 8 The Edington Burtle hoard (Somerset/GB). – (© Somerset Archaeological and Natural History Society and South West Heritage Trust, acc. nos TTNCM 24A–31B).

al variations in object types. New discoveries also indicate a greater level of fragmentation and wear present on some of the Ha C hoards (O'Connor 2007, 64). Establishing these temporal trends in relation to the treatment and selection of objects is important as they reflect social and personal approaches to forming depositions, such as the treatment of ornaments or axeheads in the Middle Bronze Age or the deliberate fragmentation of objects during the

Late Bronze Age versus the tendency to leave objects complete in the Earliest Iron Age. The condition of objects was an integral part of communicating ideologies expressed through deposition (Knight 2024).

These regional studies give a flavour of the patterns occurring but were not universal. I want to turn now to specific categories and groups of objects that highlight the variability in use and abuse in different later Bronze Age objects.

Shields and Vessels

Shields and vessels (including buckets and cauldrons) are some of the most impressive pieces of craft from the later Bronze Age in Britain (Gerloff 2010; Uckelmann 2012). They required highly skilled production techniques and were involved in communal and ceremonial activities, including combat and feasting, tying into pan-European traditions. Metal shields,

dating to the Middle Bronze Age in Britain, were typically considered purely ceremonial (Coles 1962) but experimental work by B. Molloy (2006) and the project »Bronze Age Combat« have highlighted their resilience to sword and spear blows and thrusts (Hermann et al. 2020a). They were effective at defending the lives of the combatants using them. Shields



Fig. 9 One of the three shields from Yetholm (Scottish Borders/GB), with possible sword damage on the boss. – (© National Museums Scotland).

Fig. 10 Close up of one of the Yetholm shield bosses showing damage from a probable sword thrust. – (Photo © M. Uckelmann, courtesy of National Museums Scotland).



that were sunk into the River Thames show signs of spear and sword damage (Uckelmann 2011, 193–194); another from Yetholm (Scottish Borders/GB) has a probable sword thrust hole in the boss (Uckelmann 2011, 193–194; **figs 9–10**). These were also objects that often saw special treatment in deposition, occasionally involving deliberate destruction, perhaps a physical response to their histories in combat. Several examples have been recovered from rivers, and the Yetholm shield is one of two recovered upright on their edges in a wetland area in the Scottish Borders, a careful and structured act of deposition. A third shield and a large incomplete decorated spearhead were later found on two separate occasions from the same wetland area (Cowie et al. 2016).

The earliest Atlantic bronze vessels appear during the Middle Bronze Age (Gerloff 2010) and, like shields, these also show a range of treatments. Mostly complete examples from Feltwell (Norfolk/GB), and Shipton-on-Cherwell (Oxfordshire/GB), dating to c. 1300–1100 BC, show signs of careful, upright deposition and have evidence of extensive repairs (Gerloff 2010, 50. 56 nos 2–3 pls 4–10), suggesting these were objects that were cared for until point of deposition. S. Gerloff (2010) notes repairs to varying

degrees on different cauldrons and buckets across Britain and Ireland.

A cauldron from Hattonknowe (Scottish Borders/GB), dating to c. 1100 BC, was also deposited upright and mostly complete, though was missing one of its handles (Buchan 1905; **fig. 11**), which perhaps detached through use, but was more likely deliberate. Other early examples are also missing a single handle (Gerloff 2010, 74). This appears to be less common for later vessels, but handles and attachments for cauldrons and Hiberno-British buckets have been recovered from multiple Late Bronze Age–Earliest Iron Age hoards or as single finds suggesting these are being removed and included almost *pars pro toto* elsewhere e.g. Duddingston Loch (Edinburgh/GB), Dowalton Loch (Dumfries and Galloway/GB), Gilm-onby (Durham/GB) and Meldreth (Cambridgeshire/GB) (Gerloff 2010, 272–275 nos 126–129). Fragments of vessels often occur alongside other deliberately damaged objects and it seems important to bury only token pieces of the vessels. While many vessels had long lives, eventually they were subjected to acts of decommissioning and deposition, perhaps reflecting the end of the feasting ceremonies to which they were integral.



Fig. 11 The Hattonknowe cauldron (Scottish Borders/GB). – (© National Museums Scotland).

Mixing Use and Abuse

So far, I have largely focused on material that is dominated by used and/or damaged material but the Corrymuckloch hoard highlighted that sometimes a range of object conditions might be present falling across object categories. In Turner's (2010) examination of 23 Late Bronze Age hoards from south-eastern England, all contained freshly cast, used and/or deliberately fragmented objects (Adams 2022). The Minnis Bay hoard (Kent/GB), for instance, contained more than 80 complete and incomplete objects, including as-cast, used and fragmented socketed axeheads, chisels, gouges, sickles, swords, bracelets and ingots, and was buried adjacent to a freshwater spring and near several Late Bronze Age–Early Iron Age pits (Turner 2010; Gibbons/Gibbons 2019). Previously, these hoards have been considered as accumulations of scrap or stockpiles for metalworkers (Evans 1881), and statistically it seems the numbers of objects in these hoards represent random accumulations (Wiseman 2018). However, this does not

explain why so many hoards were buried or left unrecovered, nor why they contain complete, as-cast objects, nor why they were occasionally deposited in significant landscape locales (Webley et al. 2020, 118–120). L. Turner (2010, 95–97) suggested that the hoard might represent the deliberate accumulation of objects at different stages in their life cycles. This can be supported by the seemingly selective nature of certain categories of objects that tend to dominate these hoards. Fragment-dominant hoards in south-eastern England, for instance, comprise primarily axeheads, tools and ingots, occasionally fragmented swords and spearheads, and rarely ornaments (Turner 2010). However, ornaments do feature more commonly in hoards of a similar character in France and Belgium (Huth 2003). The selection and combination of used, unused and damaged objects suggest an active process of bringing material together from a range of people, sources and cultural ideologies.

An interesting iteration of this practice can be observed at Trevalyn Farm (Rossett, Wrexham/GB), where a complete, worked and possibly used socketed axehead and tanged knife were buried together (Gwilt et al. 2005). Four fragments of at least two gold bracelets were recovered from inside the socket of the axehead (**fig. 12**). This hoard was buried in the River Alyn valley (northeast Wales/GB), in an area of long-lived depositional practices during the later Bronze Age (Gwilt et al. 2005, 43–45). Nearby, at Llanarmon-yn-Iâl (Denbighshire/GB), two coiled gold bracelets, a gold ingot and a gold link fragment were found within the socket of an axehead, recovered from a rock cleft (Green 1983). Plugged socketed objects from the later Bronze Age are well-known in Britain and other parts of Europe (Dietrich 2014; Dietrich/Mörtz 2019) and although some theories suggest the plugging of sockets gave an advantage for melting and recycling, the mixture of materials indicates there was occasionally a more symbolic purpose (Dietrich 2014). Of interest here, we can clearly identify that a premeditated process of fragmentation and decommissioning was required ahead of deposition to insert the fragments into the sockets. Fragmentation was integral to forming the final deposit.



Fig. 12 The Trevalyn Farm hoard (Rossett, Wrexham/GB). –
(© Portable Antiquities Scheme from London, England, CC BY 2.0).

Use, Abuse and Place

Lastly, we can consider the relationship between the treatment of objects and the final place in which they were deposited. This is particularly evident where the damage and destruction of individual and groups of weapons is intimately linked with watery locations (Torbrügge 1970–1971; Bradley 1990; York 2002; Mörtz 2018). At Broadward (Shropshire/GB), for instance, a large hoard comprising at least 53 spearheads, as well as fragments of swords, ferrules and other bronze objects was found during drainage operations in 1867 (Burgess et al. 1972). Many of the weapons were deliberately broken. Survey and excavation helped locate the probable findspot, with the hoard buried in a pit at the edge of a natural spring where earlier and later deposits were made (Bradley

et al. 2015). This situation echoes that at Minnis Bay mentioned above.

The Peelhill Farm hoard (South Lanarkshire/GB) is another prime example (Mörtz et al. 2021). It was recovered by chance from a boggy basin-shaped hollow during agricultural work in 1961 and comprised 55 fragments representing a minimum of 25 spearheads, one spear ferrule, one axehead, one sword and three rings. All spearheads were deliberately burnt, bent and/or broken; due to the exaggerated damage, it is hard to identify signs of use. The sword, in three pieces, however, presents some slight nicks, notches and bowing of the edges on the lower blade towards the tip. These were probably caused by physical contact with another weapon (Mörtz et al.

2021, 359–361). Nonetheless, the sword would have been usable or repairable at the point of breakage, suggesting there must have been a particular motivation for destroying this object, perhaps following its use in combat. The axehead – a rare inclusion in weapon-dominant hoards – was complete and may have been for maintaining aspects of the weapons. Alternatively, this axehead may have been involved in decommissioning the weapons, a distinct possibility as the width of the blade correlates with an impact blow on one of the spearhead sockets.

Other hoards, including smaller groups and indeed single finds, from across Britain at this time also show this link between use on the weapons and deliberate destruction suggesting that the involvement of weapons in combat may have influenced their eventual destructive ending (Mörtz 2018). Some weapons show macroscopic signs of burning, which has been verified through metallographic study, as at Duddingston Loch, Wilburton (Cambridgeshire/GB) (Bridgford 2000, 183–184) and Waterden (Bridgford/Northover 2020). The burning, bending and breaking was a performance intended to visibly and spectacularly end the lives of objects, with the sinking into water making the objects potentially irretrievable.

The treatment and placement of these objects in water occurs within a relatively confined chronological span (c. 1120–920 BC) and represents a broad cosmological belief and understanding that Bronze Age communities held at this time. Moreover, the recurrence of deliberately damaged objects in water highlights an important relationship between the treatment of certain objects and their depositional location.

This relationship for dryland finds is less clear, with a range of locations suitable for objects with various signs of wear. As noted above, the Llanarmon-yn-Iâl hoard was recovered from a rock ledge on a high natural outcrop known as Craig-yr-Wolf (Green 1983). By contrast, a hoard of a similar nature from Michaelston-super-Ely (Cardiff/GB) contained a complete but used socketed axehead with two gold fragments in the socket but was recovered from a shallow rising slope overlooking the River Ely in south Wales (Aldhouse-Green/Northover

1996). Many other single metalwork finds and hoards derive from high locations (Knight 2022a, 150–151; 2022b) or from slopes along river valleys, though not necessarily deriving from rivers themselves (e. g. Gwilt et al. 2005, 43–45; Mullin 2012; Knight 2022a, 148–150). These types of places were clearly foci for deposition, but so far, few studies have demonstrated a strong correlation with the treatment of objects prior to deposition. A field survey by D. Dunkin et al. (2020) is, however, informative.

D. Dunkin et al. (2020) undertook field visits of 333 find locations of Bronze Age metalwork in south-eastern England. Whilst they observed the presence of weapons from rivers, they also found that dryland finds were typically deposited close to springs, aquifers and confluences, that is also bearing a relationship with watery elements of the landscape. Although this study was not specifically concerned with different types of wear, it did note the nature of completeness of objects. The authors found that complete Middle Bronze Age palstaves were almost always found in wet areas of the landscape, while fragments were recovered from dry ground (Dunkin et al. 2020). The inverse was true for Late Bronze Age socketed axeheads, with complete examples commonly recovered from higher ground and nearly half of all fragmentary finds made within 200 m of water. This study highlights the research potential for future work establishing more precise relationships between certain types of objects, their treatment and placement.

One final case study that emphasises this point comes from Staffordshire. Here, two refitting parts of a sword were found on intervisible hilltops, one at Tretham (Staffordshire/GB) and the other 3 km away at Hanford (Staffordshire/GB), but the sword had clearly broken some time before deposition, with one fragment being more worn than the other (Bradley/Ford 2004). The fragments had been in circulation for different lengths of time prior to deposition. That they were deposited in relation to each other suggests that the history of this sword was recalled with the connected places of deposition serving as a mechanism for symbolically re-establishing this link (Bradley/Ford 2004).

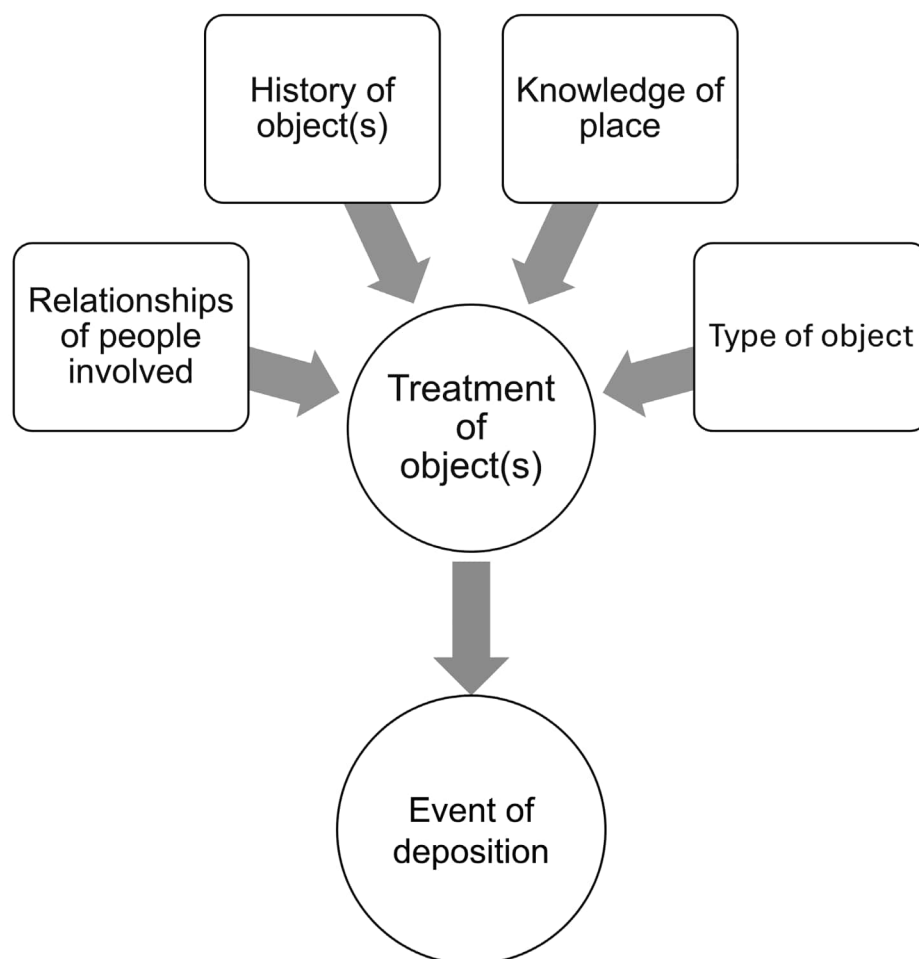


Fig. 13 Factors contributing to the treatment of objects ahead of deposition. – (Graphics M. G. Knight).

Use, Abuse and Deposition

At the start of this paper I highlighted that experimental research is changing how we appreciate and recognise signs of use and destruction on prehistoric artefacts. Experiments allow us to reflect on what constitutes particular forms of wear and fragmentation and how this can help us understand the biography of objects. The biography of objects – as interpreted through the accumulated wear – was related to the people who used the objects and reflected their concerns. This is as true for those who fragmented them.

The deposition of complete, usable axeheads alongside broken swords at Corrymuckloch, for instance, highlights that different objects were subjected to different treatments; this was in part linked to the types of objects involved but also their histories. Similarly, we have seen that the places chosen were an integral part of the treatment of the objects and the eventual event of deposition. As a result, we can

recognise that the treatment of the object(s) was a relational act that drew on a range of factors (Chapman 2000; Knight 2024; **fig. 13**). The treatment of objects, whether used, damaged or left intact, was often connected to wider ideologies and the eventual deposition has much to tell us about the relationships between people and the objects they were depositing.

This varied over time and space. While for the Early Bronze Age deliberate destruction of objects was infrequent, this became more prevalent during the later Bronze Age reflecting changes in social attitudes. It became acceptable, in some cases, to deposit only parts of objects, rather than the whole object. Sometimes, this may have been an act of *pars pro toto* where a fragment of an object was added to a deposit as a symbolic representation of the whole (e.g. Hansen 2016), but at other times, destruction was an act of decommissioning (e.g. removing a vessel handle) or was intended to obliterate

the functionality of the object (e.g. burning weapons). These acts may have been in response to wider events, such as the end of a conflict or the closing of a communal ceremony. Fragmentation became part of the performance of deposition, which involved selecting and gathering certain artefacts, some of which had visibly long use-lives, as well as choosing

places with meaning (Adams 2022, 91–92; Fontijn 2020; Knight 2022a, 159–160). It is only by recognising and understanding the multi-faceted nature of the use and abuse seen on Bronze Age metalwork, alongside critical contextual information, that we can gain insights into the diverse Bronze Age hoarding practices.

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Variations on Use and Fragmentation »in the Late Bronze Age«

ABSTRACT

The paper explores several scenarios of how Bronze Age metal objects were fragmented in the Carpathian Basin, mainly based on examples from Hungary. It intentionally follows a source-critical perspective to illustrate the varieties of phenomena that can affect the fragmentation of a metal object beyond intentional prehistoric damaging in old museum collections. Also, special examples are highlighted from the territory under research for secondary use, modification and long circulation of fragments to demonstrate how complex the life cycle of a fragment can be during the Bronze Age. Finally, a preliminary data revision of swords from the Late Bronze Age Transdanubia is presented, which is a good example of how re-examining old archaeological materials by following strong methodological and documentation protocols can bring a different picture of the phenomenon of fragmentation.

KEYWORDS

Carpathian Basin | Late Bronze Age | fragmentation | data revision | swords

By the early 2020s, European Bronze Age archaeology developed a methodological and theoretical »arsenal« for the study of prehistoric bronze objects. This tradition of a long research process that had been underway for almost a century suddenly culminated in a few decades, thanks to technological advances that brought forward a series of new and affordable devices for documenting traces, increased dialogue between craftspeople and archaeologists, as well as new natural scientific methods that greatly assist metallurgical research. Fragmentation, which is the main subject of this conference volume, complemented here with lessons learnt from the use-wear of archaeological objects, are two related sub-topics of the prehistoric research of ancient metals. Both have recently seen the publication of an unparalleled amount of new experimental archaeological and use-wear results, providing researchers working with metal finds with a large body of data to analyse.

The research question is no longer whether deliberate breakage by Bronze Age people existed or what methods were used to fragment these metal products. The research questions are increasingly aimed towards the micro-level. The magic of mysterious tool marks on fragmented bronze objects is long gone. Researchers working on fragmentation, whether interpreting microscopic images, developing experimental archaeological data, or combining both, have discovered the cause of these marks and have made well-educated guesses on what kind of tool, chisel, axe or hammer, and with what kind of technique has been used to achieve such damage¹.

The field of use-wear shows a similar trend. Unlike early studies that supported the idea that bronze objects, essentially weapons, are mainly or solely symbolic ones, useless for their utilitarian purpose, experimental archaeological research and advances in the field of metallurgy have shown that these bronze artefacts were indeed functional objects, cast

¹ Modl 2010; 2019; Knight 2019; 2022a.

and shaped into form professionally, and filled with the events of prehistoric life manifested through micro-traces. Of course, no one doubts that an artefact could not have had a symbolic function, nor could miniaturised and oversized symbolic objects for »non-ordinary use«² as well as unused as-casts and defected products have survived. But underneath the lavish exterior of most bronze objects, real usable products lie. Like a masterfully crafted Middle Bronze Age disc-butted axe from Cisek (woj. Opole/PL), the lavish decoration and fine post-casting-treated surface of which hide a quite functional and deadly weapon³.

Research was also able to replicate complex Bronze Age objects at various levels of authenticity from the very early on. A pioneer of this was Artur Pietzsch, who was able to make tin bronze Urnfield metal vessels⁴. One can read about the reconstruction of knives⁵, daggers⁶, halberds⁷, swords⁸, spearheads⁹ and other object types including the complete Dendra (Argolis/GR) panoply, which provides exciting results from combat simulation despite the fact that it was made from a modern alloy (Cu-Zn instead of Cu-Sn)¹⁰ which is hardly suitable for drawing relevant conclusions when the durability of Bronze Age armour against combat weapons is studied. The questions are therefore no longer whether researchers can replicate Bronze Age artefacts, but rather how faithfully one can replicate them, at the chemical element and production technology, and whether one can distinguish nuanced phenomena in the technology of making, using and breaking the objects.

There is now such a wealth of knowledge accumulated by various individual researchers and research groups that we have reached the stage where explosive new discoveries can be made. After all, whoever has this methodological-theoretical background as a specialist can be deployed anywhere with relatively minimal typological knowledge of the territory under research, and the expert's knowledge can be put to effective use by any research group since the principles of metal technology, object use and fragmentation are not very different in archaeological cultures with Bronze Age level of technology. This offers the potential to produce statistically representative amounts of data by experts from new and old materials, which, if able to reach a critical mass and complexity big enough to be called big data, would be analysed by algorithms, and ultimately serve as the basis of new theories and syntheses and changing our current way of thinking about the world of Bronze Age people. The Central European Bronze Age has an excellent archaeological heritage for analysis patterns of technology, fragmentation and use on a larger scale because of the high degree of formal and functional similarity due to intensive cultural contacts during this period. Over the last 100 years or more, seminal synthesis at the monographic level has been published, primarily in the form of the »Prähistorische Bronzefunde« (PBF) volumes, local hoard catalogues and individual publications, which have dealt with specific metalwork types and assemblages from country to country. In the Carpathian Basin alone, research has produced a huge, almost incomprehensible book-based dataset containing thousands of metal objects which can be used as a basis for new directions. Or maybe not?

² Patay 1995; Notroff 2009; Hellebrandt 2011.

³ Nowak et al. 2022.

⁴ Pietzsch 1968.

⁵ Schäppi 2012.

⁶ Caricola et al. 2022.

⁷ O'Flaherty 2007.

⁸ Siedlaczek 2011.

⁹ Binggeli 2011; Bader et al. 2012; Trommer/Bader 2013.

¹⁰ Mödlinger 2017, 203 tab. 3.4 (Dendra, grave 12); Flouris et al. 2024.

One Step Back

The Carpathian Basin, which the author is most familiar with, and which has provided many examples included in this paper, especially from Hungary, is a region where attempts have been made during research history to study the Late Bronze Age fragmentation patterns of individual objects, grave goods or hoards. The various works range from general characterisation, which typically means whether a particular region or period was more fragmented than the other, and are essentially based on literature. New works determined fragmentation shapes and types, and recognised certain manipulation phenomena and traces related to fragmentation. Rare exceptions were based on the re-study of the material and in certain cases, even source-critical approaches have been applied, and attempts have been made to eliminate modern effects from the fragmentation patterns¹¹. In a certain way, all of them failed. Here we arrived at the first layer of problems. The archaeological literature, whether it be local PBF volumes or catalogues containing large quantities of metal finds, is almost flawless when considered in historical context of their original research and the scientific questions it was intended to answer. In our opinion, except for the three volumes by József Hampel written in 1886, 1892, and 1896, which were well beyond the level of the 19th century¹², relevant Carpathian syntheses for Late Bronze Age metals were produced from the 1960s onwards; perhaps a symbolic starting date was the 1968 work of Wilhelm Albert von Brunn¹³. This book inspired numerous catalogues¹⁴ and PBFs¹⁵ and PBF-like syntheses¹⁶. Many of them followed unspoken the concept of von Brunn, resulting in the development of various chronological schemes generally within

modern national borders. The main goal was the development of the foundation, relative chronological schemes, a framework that would allow the already immeasurable Southeast European metal finds from the Eastern Bloc to be sorted in some form and linked to the desired Western chronology. It would fill a whole series of separate papers to discuss the extent to which these relative chronological schemes within national boundaries have achieved their purpose in the case of the Carpathian Basin, where bronze artefacts bare slight regional typological differences. But let us accept that this ambitious work has succeeded, since these syntheses are still the basis of our dating today due to the lack of absolute chronology for hoards and metals. In them, the highlighted typologically relevant objects, selectively published assemblages, brief descriptions of objects, and black-and-white drawn or photographed plates of varying quality are basically suitable for typo-chronological analysis and have been of great help in seeing this large archaeological material in a coherent way. At the same time, we must realise that they are rarely suitable for answering the questions of technology, hoard selection, fragmentation, object use or biography because of their typo-chronological orientation. The data necessary to answer these questions are simply not included in these works, which is of course not the fault of their authors since they were not intended to answer them during their research period. This in turn means that, although we can get a good overview of the material and perhaps what objects could be potentially fragmented or used, one cannot extract real fragmentation and use-wear data patterns from former synthesising literature. This must be done again by re-studying the

11 Hansen 1994, 355–363; Vachta 2008; Bratu 2009; Rezi 2011; Novák/Váczi 2012; Hansen 2016; Fejér 2017; Tarbay 2022a, 137–148.

12 Hampel 1886; 1892; 1896.

13 von Brunn 1968.

14 Novotná 1970a; Mozsolics 1973; Vinski-Gasparini 1973; Garašanin 1975; Petrescu-Dîmbovița 1977; 1978; Kemenczei 1984; Mozsolics 1985; Garašanin 1994; Teržan 1995–1996; Kemenczei 1996; Kobal' 2000; Mozsolics 2000.

15 Novotná 1970b; Vulpe 1970; Vladár 1974; Vulpe 1975; Kilian-Dirlmeier 1975; Novák 1975; Petrescu-Dîmbovița 1978; Novotná 1980; Hüttel 1981; Bader 1983; Novotná 1984; Kemenczei 1988; Patay 1990; Kemenczei 1991; Bader 1991; Novotná 1991; Žeravica 1993; Vasić 1994; Harding 1995; Weber 1996; Petrescu-Dîmbovița 1998; Vasić 1999; Novotná 2001; Glogović 2003; Vasić 2003; Furmánek/Novotná 2006; Vasić 2010; Novotná 2014; Vasić 2015.

16 Furmánek 1980; Soroceanu 2008; Leshtakov 2015; Jankovits 2017; Pavlin 2023.

assemblages on site in the museum collections. To understand why such a revision of data is needed, we need to dive deep into the processes that an object goes through and the variations in the use and fragmentation of Bronze Age objects.

First, one needs to be aware of how to construct reliable fragmentation and use-wear patterns of large quantities of Bronze Age material in such a way that the result is closest to the object's condition at the time of discovery, and embrace the different possibilities of how fragmentation and use-wear patterns of an assemblage could have occurred in the studied prehistoric period. In this way, individual data distortion and misinterpretation of patterns can be avoided. To do this, we must accept the fact that the use-life of objects is continuous and not limited only to prehistory. Whether they are buried or after discovered (post-discovery), objects are subjected to a myriad of effects that can change their use and fragmentation profile, even radically when compared with their prehistoric state of deposition. The result that we see under the most sophisticated microscopes compared with easy-to-use microscope cameras can be completely different. Archaeological research is aware of these effects, whether they are caused by taphonomy processes, corrosion, recovery damage, modern intentional damage and reuse, invasive and outdated conservation techniques, or unfortunate curation history¹⁷.

In our experience, identifying modern post-recovery damage, which now typically refer to damage that occurred between the 19th and 21st centuries, is easy to detect because there is typically a surface that is quite different in colour and texture from those of the Bronze Age. The colour of these fresh break surfaces ranges from reddish to yellowish or greyish depending on the elemental composition of the studied find; no patina or corrosion can be observed on their surface. Sometimes they are combined with

the breakage of the patina. They can be seen on new objects prior to conservation but are also visible on old finds that have been treated superficially or partially conserved (**fig. 1**)¹⁸. In spite of the awareness of modern damage and its cause and easy identification, there has been less in-depth consideration of the phenomenon, particularly regarding the fragmentation of metal objects and use-wear analysis. Therefore, I would like to highlight some examples, mainly from our own research, that have encouraged me to take more careful steps during data evaluation, and I also hope that it inspires others to take a more critical approach to the studied material.

Hoards will be given as examples, as this is one of the most common types of Late Bronze Age metal assemblages in the Carpathian Basin, and are the examples most exposed to various forms of modern affects. Ideally, a hoard is documented through archaeological excavation, which in the case of Hungary fortunately became more common thanks to the Community Archaeological Programmes of the County Museums and the Hungarian National Museum¹⁹, and, of course, the pioneering research project at ELTE University in Budapest²⁰. This resulted in an increase in the number of excavated hoards compared to the last 200 years of local research, and opened up new theoretical and methodological possibilities. Excavated finds are carefully packed, transported and conserved in laboratories by experts under highly supervised conditions, and ideally the specialists studying the fragmentation and use-wear traces on them see clear patterns without any distortion.

Naturally, anyone who has excavated a hoard cannot paint a rosy picture of excavated finds either, since even the most careful archaeological excavation can result in minor damage due to packing and transport, especially in the case of objects with poor preservation conditions. However, these breakages are not common, and they are generally micro-frag-

¹⁷ Kristiansen 1999, 101; Bridgford 2000, 30–32. 56–57. 126; Quilliec 2008, 69; Mödler/Trnka 2009, 353; Mödler 2011a, 9. 83; Horn 2013, 32–33. 35–36. 40; Guitérrez Sáez/Martín Lerma 2015, 175. 180–184; Horn 2015, 203; Dolfini/Crellin 2016, 79. 83; Molloy et al. 2016, 80–81; Tarbay 2017b; Horn 2017, 264; Bunnefeld 2018, 200; Bell 2019; Havlíková/Křišťuf 2019, 461–462; Horn/Karck 2019; Gentile/van Gijn 2019, 139; Gentile 2022, 6; Knight 2022a; Tarbay 2022a, 65–67; Kudelić et al. 2023, 10.

¹⁸ Higgins 2010, 198; Mödler 2011a, 83; Křišťuf et al. 2017, 25–28; Amkreutz et al. 2019, 116–117; Bell 2019, 153. 159–163 figs 10.14; 10.15c; Havlíková/Křišťuf 2019, 461; Hermann et al. 2020b, 1056–1057; Tarbay 2021a; 2022a.

¹⁹ Rácz 2019; 2021; Wollák/Anders 2021.

²⁰ V. Szabó 2019.



Fig. 1 Modern break and bending of a rapier (1-2) from Kisapostag (Fejér County/HU), River Danube. Hungarian National Museum, Budapest. – (Photo and drawing J. G. Tarbay).

tures and micro-breaks that occur when objects are extracted from the ground or due to friction with the packaging material (**fig. 2, 1**). Bladed tools and weapons are particularly vulnerable to this type of damage. If these are not documented immediately after extraction on site, after transportation and before conservation, they can easily be confused with the type of wear trace typically referred to in the literature as an indentation or dent²¹ (**fig. 2, 1-2**).

However, the reality is that many of the Bronze Age artefacts we have at our disposal in museum collections were not found by archaeologists but by civilians, farmers, builders, dredgers, and even playful children who typically knew little about what they had found and what kind of metal it was made of. Unfortunately, this is true not only of the Late Bronze Age hoards found in Hungary²² but also in any of the neighbouring countries of South-eastern Europe based on brief notes in the relevant regional hoard catalogues from Slovakia²³, northern Croatia²⁴, Romania²⁵, western Ukraine²⁶, Serbia²⁷, and Slovenia²⁸. In these works, we will see references to discoveries by locals, confiscation of finds, purchases from private collectors or art dealers, and significant

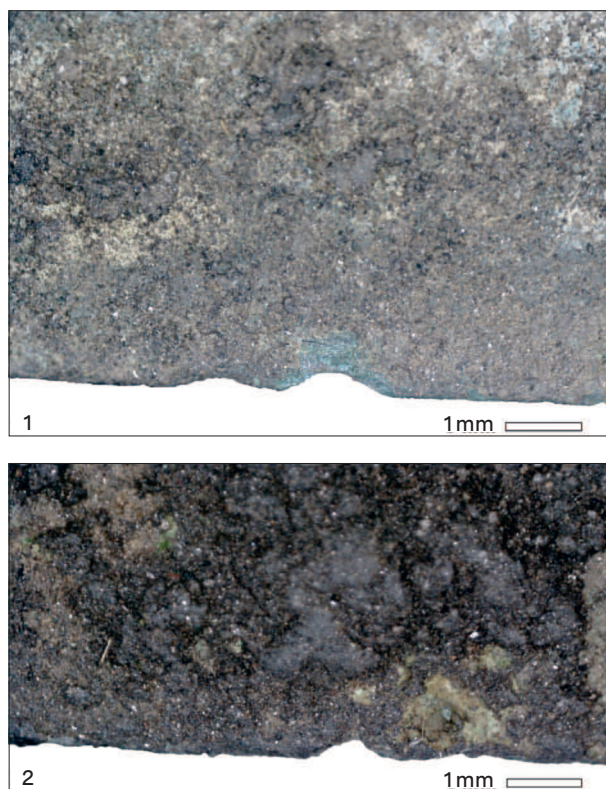


Fig. 2 Somló Hill, Hoard III: 1 Post-recovery dent on an unrestored artefact. – 2 Prehistoric dent on an unrestored artefact. – (Micrographs J. G. Tarbay).

²¹ Bridgford 2000, 105 pl. 3.3 (II); Higgins 2010, 198 fig. 10; Horn 2013, 22 fig. 2d; Melheim/Horn 2014, 10 figs 3, B15126; 4, B17619; Amkreutz et al. 2019, 116 fig. 3B; Bell 2019, 153 fig. 10.1c; Gentile/van Gijn 2019, 136-137 fig. 5.B; Horn/Karck 2019, 2. 9 fig. 1.b; Hermann et al. 2020a, 26. 32. 93 figs 4.13; 4.32; 4.187; Caricola et al. 2022 & Supplementary Materials, 7 fig. S6.C-D; Kudelić et al. 2023, 10 fig. 7.g.

²² Mozsolics 1973; Kemenczei 1984; Mozsolics 1985; 2000.

²³ Novotná 1970a.

²⁴ Vinski-Gasparini 1973.

²⁵ Petrescu-Dîmbovița 1977; 1978.

²⁶ Kobal' 2000.

²⁷ Garašanin 1954; 1975; 1994.

²⁸ Teržan 1995-1996.



Fig. 3 Fragmented jug (1–2) from Somló Hill, Hoard III. – (Photos J. G. Tarbay).

losses of finds that are far from ideal for extracting relevant fragmentation and use-wear data to serve as a basis for statistics.

Humans are curious, and when their instincts kick in in the heat of excitement due to a discovery, this characteristic is less beneficial for the intact preservation of archaeological artefacts. Curiosity

can manifest in many ways. Questions like: »What is in it?«, »How does it work?«, »What is it made of?«, and »What did I find?« can lead to wrong actions that can cause a damage or even the complete destruction of objects. Several archaeological features that contain hoards, such as pits have perished when finders dug them up completely. Also, numerous ceramic vessels, whose fragmented state and use-wear characteristics are an important element of the whole assemblage have been lost for research this way. Ceramic pots, even if they are containers of metal finds, have their own story to tell. As an example, the ceramic vessels, a jug and bowl from the Somló Hill, Hoard III (Veszprém County/HU) assemblage can be introduced here, which were excavated by the author and his colleagues, and which contained hundreds of carefully arranged metal and non-metal objects. The jug (**fig. 3**) was deposited in a broken state with the bottom missing, probably due to a technological production error and a small piece has broken off at the rim. The rim of the fragmented jug was covered with an originally intact, but during discovery, a fragmentary bowl due to taphonomy reasons. The hoard also contained macro botanical remains of millet (cf. *Panicum miliaceum* L.), a type of wheat (*Triticum* sp.) and lentils (*Lens culinaris* L. subsp. *microsperma*), which testify to what may have been the last use of the vessels and the act of depositing (**fig. 3**)²⁹. If the Somló pots had not been excavated but found accidentally, say, during vineyard work instead of an archaeological metal-detecting survey, they probably would have been tossed to the ground and broken into pieces, and at best, only a few potsherds would have made it to the museum. Direct human interaction may not be necessary to destroy these finds, as harvester and construction machinery, both 19th-century and modern, can break vessels into pieces quite easily. Ploughing not only damages any finds, but in many cases also destroys the context, leaving minimal information about the arrangement of objects. If the position of each find is recorded by GPS coordinates on site, they are aligned in the field according to the direction of ploughing.

²⁹ Petó 2024; Soós et al. 2025.

A good example of modern plough damage and the destruction of a context is the Hajdúböszörmény-Hetven-laponyag hoard (Hajdú-Bihar County/HU)³⁰.

Finders may take objects apart, try them out, or use them instantly to experience how they work. Wire jewellery can be subjected to various bends and breaks. Sheet metal objects, whether bronze or gold, can become crumpled or be straightened out of their original deposition state to see how they were decorated, which destroys the objects' original manipulation state and what Bronze Age people left us. There are some types of Bronze Age objects that attract modern damage the most, like spearheads and swords. Many finders will feel an urge to try them out and causing textbook blade-on-blade contact use-wear traces on them, which are completely identical to experimental archaeological ones. Only the patina break would differentiate them. This above phenomenon can be illustrated by a frightening number of examples from the practice of re-examining museum artefacts. Here, two examples will be given from the Transdanubian Urnfield culture, for which both observations and early literature data on the purchase of the object coincide. The first example is the Liptov-Högl type sword from Baracska (Baracska-Homokbánya, Fejér County/HU), which appeared several times over the years, but only its very first 1913 publication contains relevant information on the fragmentation and use of the objects³¹. Prior to its arrival at the Szent István Király Museum in Székesfehérvár as a donation from the parliamentarian Andor Csontos, the sword, found around 1912 in a sand mine at Baracska, was used by its finder for cutting reeds for a roof³². Based on the modern traces on the sword, it is also quite certain that it was not only used for reed cutting but also for modern sword fighting, judging by dents (fig. 4, 1–2), V-³³ (fig. 4, 4)

and U-shaped notches (fig. 4, 3)³⁴ along with a patina break along its cutting edge³⁵.

The other example is one of the largest hoards from Transdanubia. It is the Nadap-Jánoshegy hoard (Fejér County/HU), which was deep-ploughed and found by local children who climbed up the hill to pick wildflowers for decorating the village church. János Makkay's 2006 work describes in detail the moment of discovery and the fate of the objects prior to the museum purchase, and of which we will highlight one moment that affected this hoard fragmentation and use-wear pattern. »They [children] collected a few unbroken bronze spearheads, hafted them and then climbed down to the large open area at the border of the village where they started to fight. On their way down, they crossed a small depression on the slope, full of rainwater, where they played with some flat bronze objects, esp. fragments of sieving vessel and the greaves«³⁶. Thanks to the children, edge damage was caused along the spearheads' blades. Without knowing the circumstances of their discovery, they would probably have been interpreted as traces associated with slashing movements (fig. 5, 2, 4–6)³⁷. The morphology of this damage, as in the case of the sword from Baracska, compares well with the experimental archaeological results. The play with the greaves may have resulted in numerous fractures and bends. These have been reconstructed in some cases by museum conservation. But the conservation technique of the artefacts makes it very difficult to determine what the original condition of these weapons might have been, and it also limits the chance to differentiate between the modern damage caused by children and the prehistoric damage (see below).

What the object is made of is a question that could lead to the almost complete destruction of ar-

³⁰ Haldenby/Richards 2010; Tarbay 2017a.

³¹ Marosi 1913, 190 fig. 1; Kemenczei 1991, pl. 30, 128.

³² Marosi 1913.

³³ Bridgford 2000, pl. 3.3 (III left); Molloy 2011, 75 note 21 fig. 5.B; Bell 2019, 153 fig. 10.1b; Gentile/van Gijn 2019, 136–137 figs 4.D; 11.B; Hermann et al. 2020a, 24, 29, 92, 109 figs 4.6; 4.22; 4.185; 5.27 (round notch, sharp notch); 2020b, 1055 tab. 5 (round notch).

³⁴ Bridgford 2000, 283 pl. 3.3 (IV left); Higgins 2010, 197–198 figs 7 (V-shaped notch); 9 (angled V-shaped notch); Molloy 2018a, 214 fig. 10.8;

Bell 2019, 153 fig. 10.1a; Gentile/van Gijn 2019, 136–137 fig. 4.A–B; Hermann et al. 2020a, 25, 35–36, 43, 46–47, 92 figs 4.10; 4.41; 4.44; 5.65; 4.73; 4.76; 4.184; 2020b, 1055–1056 tab. 5 (sharp notch & straight graze).

³⁵ There are only a few dents along the cutting edge of the Baracska sword, which may be of prehistoric origin.

³⁶ Makkay 2006, 135–136.

³⁷ Schauer 1979; Anderson 2011.

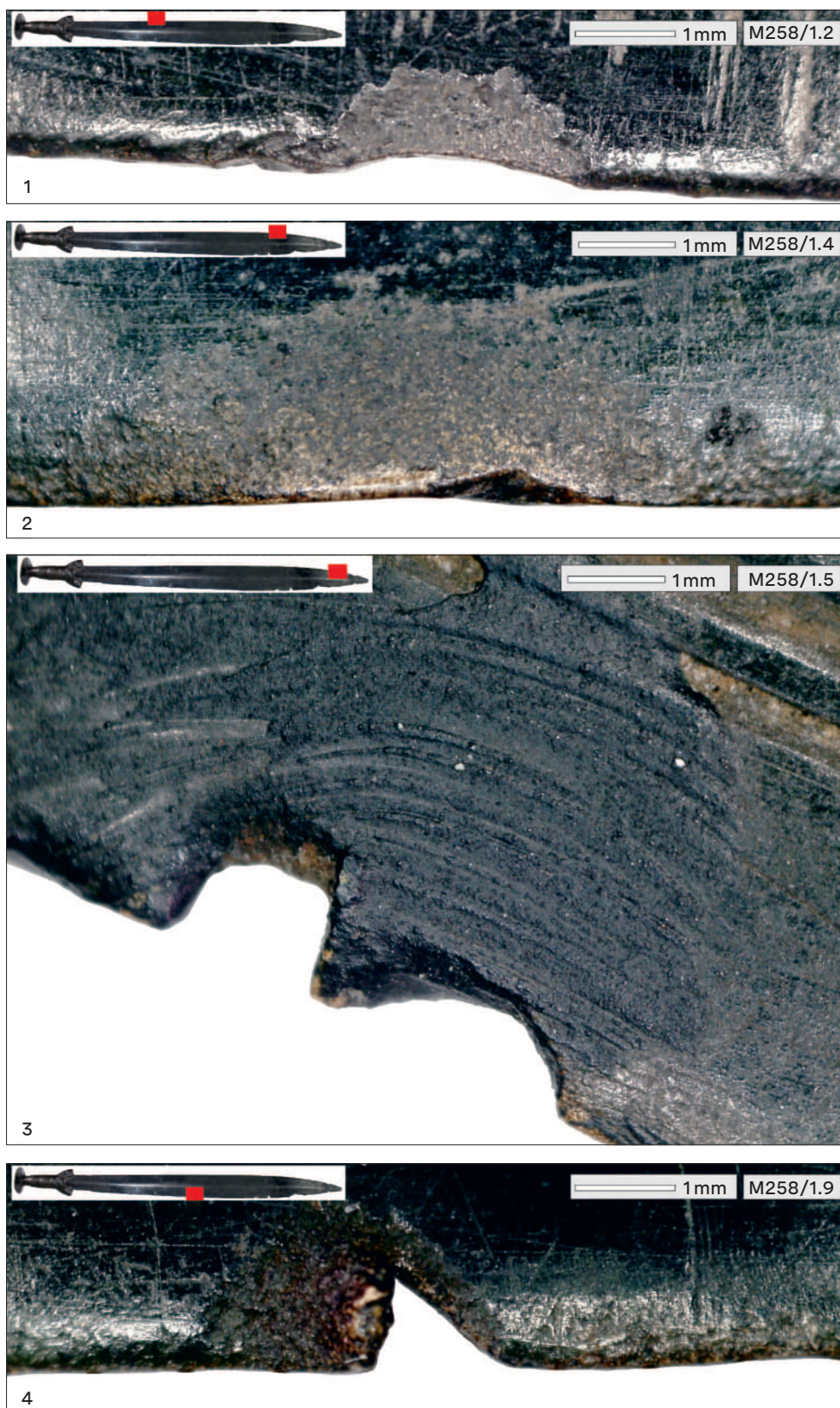


Fig. 4 Modern damage on the metal-hilted sword from Baracska-Homokbánya: 1-2 Dents with patina break. – 3 Modern U notches. – 4 Modern V notch. – (Micrographs J. G. Tarbay).

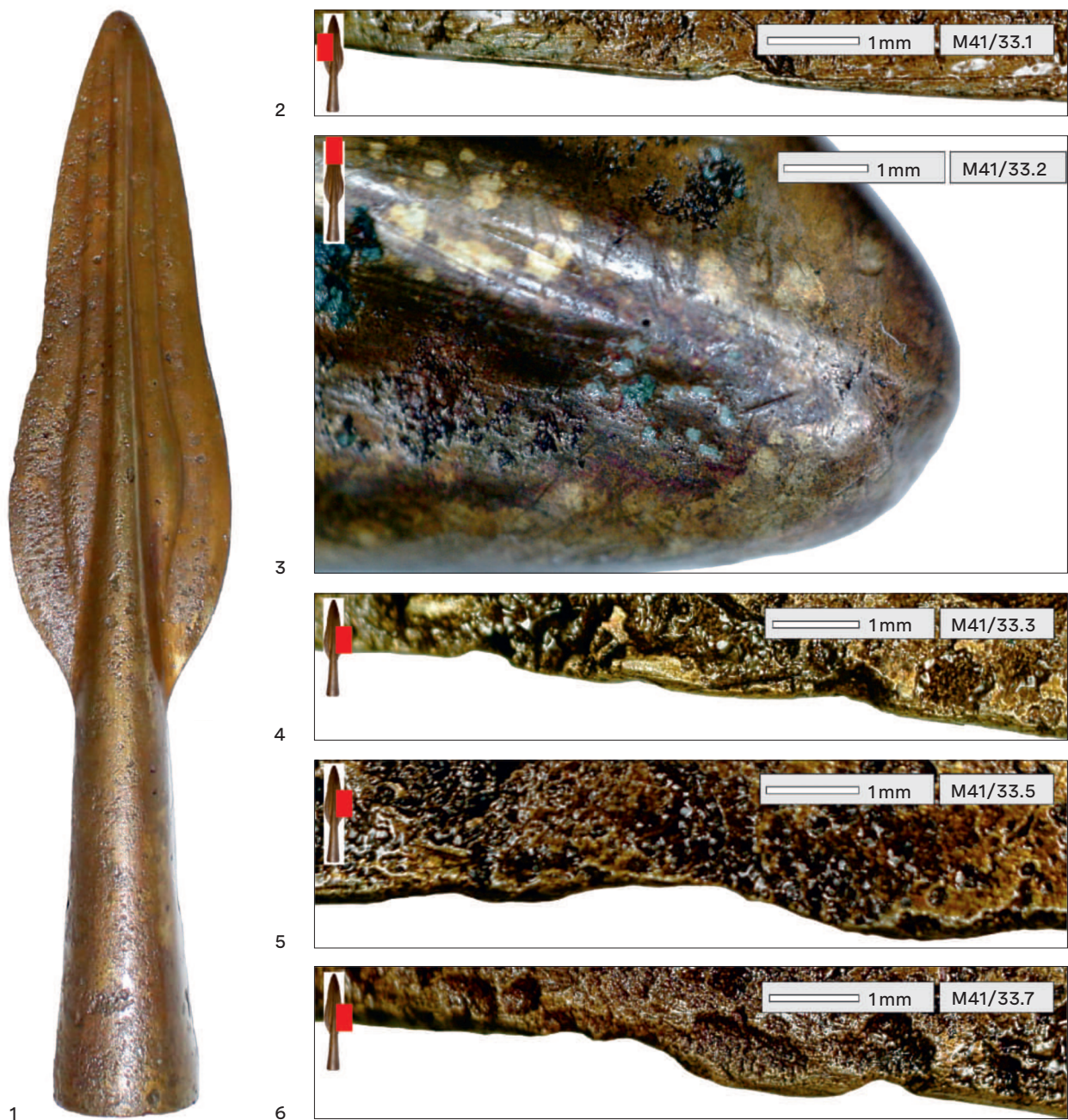


Fig. 5 A complete spearhead from Nadap-Jánoshegy with Late Bronze Age use-wear trace of a re-shaped tip (1, 3) and potential modern edge damage caused by children (2, 4–6). Szent István Király Museum, Székesfehérvár. – (Photos J. G. Tarbay).

tefacts. With 19th- to 21st-century steel tools, virtually any type of object can be broken without any professional expertise. The best example is the massive plano-convex ingot from Szombathely (Vas County/

HU), which was broken into small pieces by the gravediggers who found the hoard. Modern break surfaces are clearly visible on this object³⁸. In the worst cases, the finders use the services of special-

³⁸ Tarbay 2022a, 66 fig. 3.5.4.



Fig. 6 What has remained from the Late Bronze Age gold hoard from Uppony. Hungarian National Museum, Budapest. – (Photo J. G. Tarbay).

ists, just as in the Bronze Age, who systematically cut up the artefacts to remelt them. This is what has happened, for instance, with two large plano-convex ingots from the Ha B1 hoard found in Nagyrábé (Hajdú-Bihar County/HU)³⁹. An excellent example of a modern fragmentation pattern is the gold hoard from Uppony (Borsod-Abaúj-Zemplén County/HU), whose circumstances of discovery were published in the 1879 volume of *Archaeologiai Értesítő* exactly to illustrate how even the most valuable hoards can fall victim to modern fragmentation and secondary use⁴⁰. The Uppony hoard was found on 14 October 1844 on the estate of the *seminarium cleri junioris* of Eger in the outskirts of Uppony, on a rocky place called Kalicza when Mihály Kántor's sheep ran over a ceramic pot containing several gold objects. The shepherd thought that he had found brass objects, probably because the usually high Ag-content of prehistoric gold has a pale colour instead of a shiny gold one. He shared half of the hoard with his shepherd boy Laczi Czifra and made pipe tampers from the gold wires as gifts. He sold the rest of the finds to Sámson V., a Jew at Sáta for well below its value (55 váltógaras)⁴¹. What has been re-collected and lat-

er deposited at the Hungarian National Museum is only a fraction of the once imposing Uppony hoard⁴². The condition of the objects now is completely different from when they were found in 1844, as the shepherd had broken and damaged them (fig. 6). Without the archival records collated and published by Gy. N. in 1879, it would be impossible to determine the original deposition condition of these gold objects. One would probably interpret the objects as fragmented raw material stock of a Bronze Age goldsmith, rather than our thoughts that revolve around a ritual elite hoard, which was most likely deposited intact without intentional fragmentation. New hoards from Bükkzsérc-Hódos-tető (Borsod-Abaúj-Zemplén County/HU) excavated roughly 60 km from the Uppony site contain typologically identical gold spiral coils and gold foil domed discs. Intentional prehistoric damage was only observed on a few pieces from Bükkzsérc, which strongly implies that the objects from the Uppony hoard should have been in a similar deposition condition upon discovery⁴³.

Baracska, Nadap and Uppony illustrated how the fragmentation profile of an artefact or an entire as-

³⁹ Mozsolics 2000, 60.

⁴⁰ N. 1879, 115-116; Szendrei 1883, 136 no. 44 pl. 2; Hampel 1892, 167; Mozsolics 1973, 52 note 52.

⁴¹ N. 1879, 115-116.

⁴² Here, it also went through rounds of losses, as according to the 1958 revision note in the inventory book, its pieces were also lost in the museum collection. Inventory Book of the Hungarian National Museum 1879.57.1-9.

⁴³ V. Szabó 2016, 172-175 fig. 10; 2019, 147-155 figs 124-125.

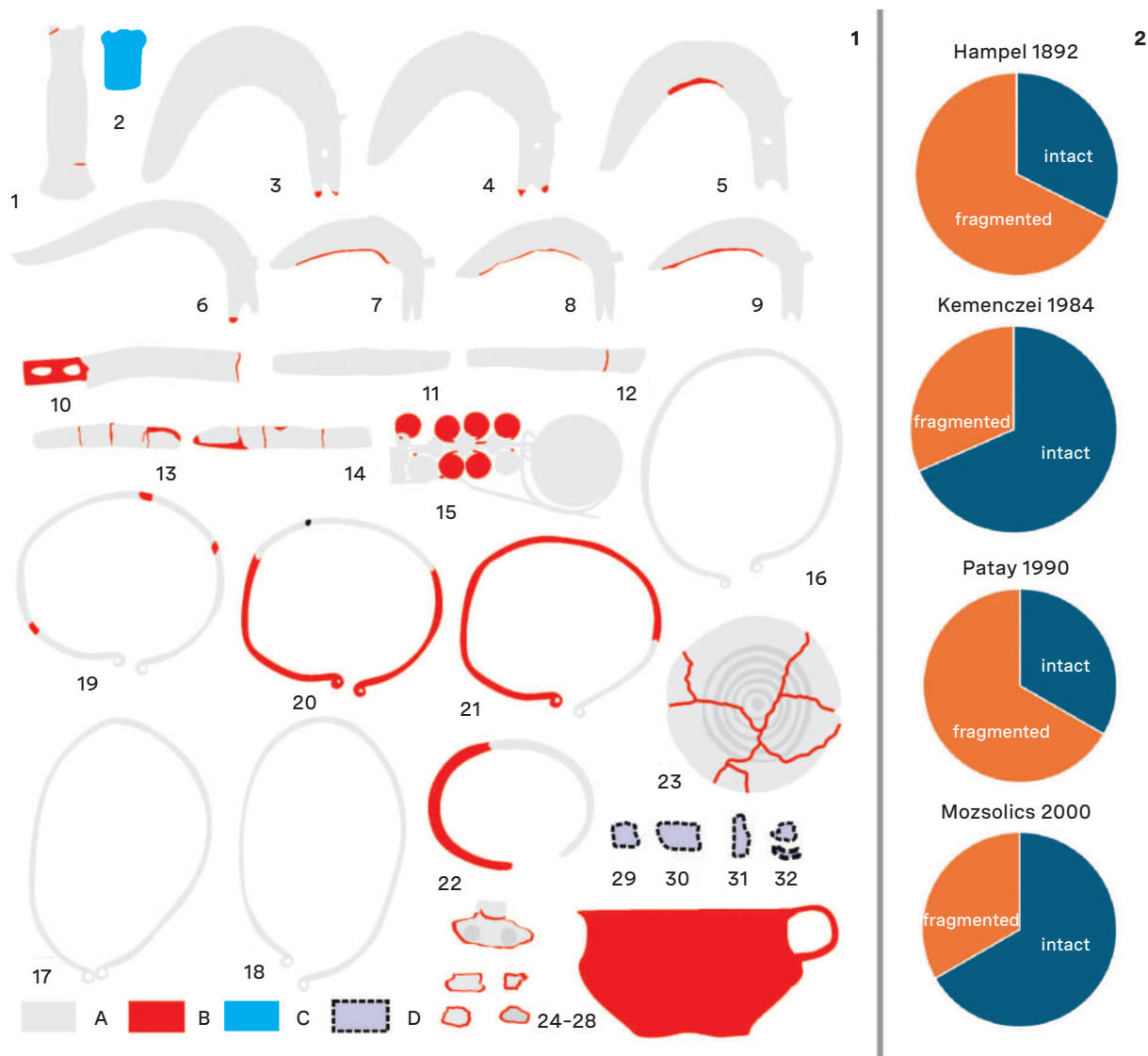


Fig. 7 1 The fragmentation pattern of the Kenderes hoard: A Intact parts; B Modern breakage; C Prehistoric breakage; D Lost objects. – 2 The fragmentation pattern of the Kenderes hoard by Hampel 1892, pls CLVII–CLVIII; Kemenczei 1984, 176 pl. CXCIX; Patay 1990, 69 pls 45, 112; Mozsolics 2000, 53 pls 48; 49, 1–5. – (Graphics modified after Tarbay 2025, fig. 7).

semblage can undergo extreme change due to post-recovery damage. While this can typically be properly reconstructed by studying early literature and archive documents, there are also several cases where we have minimal or no information at all about the circumstances of discovery. During the re-analysis of the Ha B1 Kenderes⁴⁴ hoard (Jász-Nagykún-Szolnok County/HU), we faced similar challenges. Archive documents that would clarify the circumstances of its discovery around 1886 were either lost or destroyed during World War II. The only information on composition of the hoard and its fragmentation

is what József Hampel⁴⁵ has published, along with and the results of the new use-wear analysis. If one reconstructs the fragmentation profile of this hoard from literature, it may show different patterns, depending mainly on whether the small fragments were published and the extent to which the objects were refitted (**fig. 7**). What these publications had in common was that they all showed the image of a fragmented hoard, containing many broken objects. A 2024 re-analysis of the assemblage revealed a very different picture. In the case of the Kenderes hoard, or rather the remains of a hoard, all but one breakage

⁴⁴ See with further references Mozsolics 2000, 53; Tarbay 2025.

⁴⁵ Hampel 1892, 63 pls 157; 158, 21–37.



Fig. 8 Modern damage on the swords from Krasznokvajda, probably caused by ploughing. Hungarian National Museum, Budapest. – (Photo J. G. Tarbay).

surface is modern, and most of the objects can be refitted along the breakage surfaces. Some parts of broken objects are missing, suggesting that not all the parts of the objects could have been recovered⁴⁶.

These assemblages when the fragmentation pattern is reconstructed on a larger regional scale without checking the objects in museum collections pose inherent difficulties. The best example may be the sword hoard from Krasznokvajda (Borsod-Abaúj-Zemplén County/HU). This assemblage is primarily part of a Late Bronze Age weapon deposition pattern discovered in the North-eastern Carpathian Basin, which may be the result of warrior life cycle rituals or a sacrifice of the weapons of the defeated. In either case, the intentional breakage of the swords is an important addition to the interpretation. Krasznokvajda appears in the literature as a hoard containing more fragmented swords than intact⁴⁷. The reality is closer to the Kenderes hoard, as only two of the swords have fragmentation patterns that may be associated with prehistoric breakage. Among the damage, one can observe deep cut marks left by the tractor and different kinds of breakage of modern origin, probably caused by the finder (**fig. 8**)⁴⁸. One might ask, if the fragmentation pattern of this hoard is so different when re-analysed, what are the others like?

Breakage that occurs after the purchase of the artefacts during the curation history can take many forms, from minor and repairable damage caused by careless handling during installation in an exhibit, transport, to major ones caused by simple barbarism. A good example of the latter is the »Podhering« sword hoard from Transcarpathia, West Ukraine⁴⁹. If we compare the 1880 work of Lehoczky⁵⁰ with the archive drawings of Kemenczei for his PBF volume made prior to 1991⁵¹, it appears that significant changes occurred; one of the swords was broken into two, while another was also broken and heavily fragmented (**fig. 9**). Well-observable modern break surfaces also support this assumption. The cause of

⁴⁶ Tarbay 2025.

⁴⁷ Vachta 2008, 56 fig. 37.

⁴⁸ Mozsolics 1972; 1985, 22-23; Vachta 2008, 48-58 figs 29. 36-37; Soroceanu 2011.

⁴⁹ See with further references Kobal' 2000, 93; Tarbay 2023.

⁵⁰ Lehoczky 1880, pl. 30, 8. 14.

⁵¹ Kemenczei 1991, pls 75, 529; 76, 531.



Fig. 9 Two swords (1–2) from Podhering damaged during curation history. – **A** Original state published by Lehoczky 1880. – **B** Tibor Kemenczei's original PBF drawings (c. prior to 1991). – **C** Photographs of the swords in 2023. – (Photos E. Duong Li/A. Ferancz).

this vandalism is unknown; in the case of old collections like that of the Hungarian National Museum, such destruction is usually explained by the World Wars. There is also additional modern damage to

these swords, which is very likely related to the finders who may have caused changes to conditions of the objects upon discovery. Like the Krasznokvajda sword, in the literature the Podhering hoard also ap-



Fig. 10 An unprovenanced sword (1–3) showing acidic treatment. Mátyás Király Museum, Visegrád. – (Photos J. G. Tarbay).

appears as heavily fragmented. Originally, it must have been much more intact⁵².

Even with the most rigorous methodological preparation, there can be obstacles to determining the temporality of fragmentation and use if the initial condition of the artefacts is not documented and

they underwent conservation before being studied. Mostly during the 20th century, even until the 1990s in East Central Europe, the conservation process was not well documented, and there is no record of what chemicals the objects were treated with or the exact methods used for conservation. In Hungary,

⁵² Vachta 2008, 56 fig. 37.

Fig. 11 Changes in the colour of modern damage on a sword from the Danube before (1) and after restoration (2). – (Photos E. Tóth/G. Nyíri).



which was once part of the Soviet bloc, quantity of work was favoured over quality. Conservation also caught up with the Stakhanovite movement, and the typical method chosen to achieve overperformance was to use acids (hydrochloric acid, sulphuric acid), which removes corrosion and patina, including every trace of modern and prehistoric traces of production, use and fragmentation⁵³. The result is an obliterated shiny surface topography on which it is hard to differentiate modern damage from prehistoric damage⁵⁴. An unprovenanced Ennsdorf-type flange-hilted sword from the Mátyás Király Museum in Visegrád also fell victim to this process (fig. 10). The find is completely unsuitable for any kind of observation that would date the time of the tip and hilt breakage or the use-wear damage along the edges⁵⁵. Other methods, which are sometimes necessary to use for conservation purposes, can also change the surface of the object. A new metal-hilted sword from a wetland area was treated in such a way to reveal chronologically important decoration and typological details. It was soaked in alkaline glycerines

(a combination of sodium hydroxide and glycerol), and following each soak thoroughly neutralised with distilled water⁵⁶. This careful method causes the same changes in colour to the surface, making modern and prehistoric damage indistinguishable from each other (fig. 11). In the case of finds conserved by acidic treatment and finds whose restoration process is undocumented which has caused changes in the surface topography, it is important to treat the fragmentation and use-wear pattern with caution, as their inclusion in any large series of statistics risks mixing modern breakage and use-wear traces and thus distorting the data.

The above examples highlight several problems with the nature of studied material in museum collections. On the one hand, they make us wonder to what extent the thousands of objects published in the literature could lead to data distortion. Now, at least in the case of Hungary, we believe that without a systematic re-documentation of all artefacts in museum collections, it is hardly possible to say anything meaningful about these phenomena on the re-

⁵³ Pers. comm. Eszter Tóth, metal conservator (Hungarian National Museum).

⁵⁴ Guitérrez Sáez/Martín Lerma 2015, 175.

⁵⁵ Inv. no. 2004.27.15.

⁵⁶ Pers. comm. Eszter Tóth, metal conservator (Hungarian National Museum).

gional scale. In principle, all available information should be extracted from archive records, photographs, and literature and collated to gain as accurate a picture as possible of the circumstances of the discovery and collection history of the finds. Once this has been done, a systematic use-wear analysis should be carried out to document all types of post-recovery and curation history damage, and include photogra-

phy and microscope images, in the same rigorous ways as prehistoric damage has been. Building new databases by applying a source-critical attitude, documenting objects in such a way both on site again in the museum, clearing the datasets of problematic finds that would distort the data, and making it possible to reconstruct the state of objects at the time of hoarding.

Bronze Age Variations

Even if the original deposition conditions of a formerly found assemblage can be reconstructed, the question remains: what do we see? Deciphering this mystery is perhaps even more challenging than identifying modern damage. When we look at a diagram of fragmented objects in a metal assemblage like a hoard, the first thought that comes to mind is that the fragmented hoard is the result of a single event that happened at the time of hoarding. This means different things to different people, depending on their research interests. Some may relate it to the violent destruction of goods as part of a ritualistic performance. Profane-minded scholars may see this as the result of a breakage operation for creating raw materials, or proto money following exact weight units. There are certainly such hoards that have been discovered where a singular act caused the breakage of all deposited objects, or some of the object manipulations occurred at the time of deposition. But the temporality of Bronze Age fragmentation certainly could have been more complex, and it is more likely that the collection of fragments was created at different times and for different reasons; some may relate to hoarding, others not so much⁵⁷. Bronze Age objects were made for use; whether they are sickles for harvest, axes for wood cutting, spearheads for combat and hunting, or representative jewellery, they were used by people, and any use causes damage, be it micro-wear or breakage. A hoard, a grave, or a pit is essentially the final collection point

of objects and fragments with different life-paths. Breakage may not occur simultaneously; it is possible that days, months, years, or, in extreme cases, even centuries could have passed between incidents of damage. The temporality of hoarded objects, and the potential that their breakage occurred at different times can be seen through the typo-chronological and use-wear characteristics of the hoarded finds. Wilhelm Albert von Brunn and researchers following his footsteps⁵⁸ have pointed out that the material of each Carpathian hoard horizon is not homogenous, and objects characteristic of older periods than the supposed time of deposition appear in the content of younger ones. Multi-period hoards, which are becoming more and more apparent in research as the old horizon models are being revised, also fit well with these lines of thought. Some assemblages even contain out-of-time objects, but whether these were broken at the moment of deposition or their previous breakage had a strong symbolic meaning for the act of hoarding cannot be known⁵⁹.

Ideally, if an object has been broken several decades prior to deposition, the pieces collected and then transported for any length of time, macroscopic traces in the guise of abrasions should occur on their surface. In practice, this is hard to differentiate, although in excavated hoards one can see that some artefacts have clean and sharp break surfaces while others seem to be worn. Use-wear patterns of assemblages like hoards are useful to reveal such trends.

⁵⁷ Primas 1990, 86–87; Tarbay 2022a, 74–75. 114.

⁵⁸ von Brunn 1968; Mozsolics 1985; Kemenczei 1996.

⁵⁹ Hansen 2016; Knight 2022b.

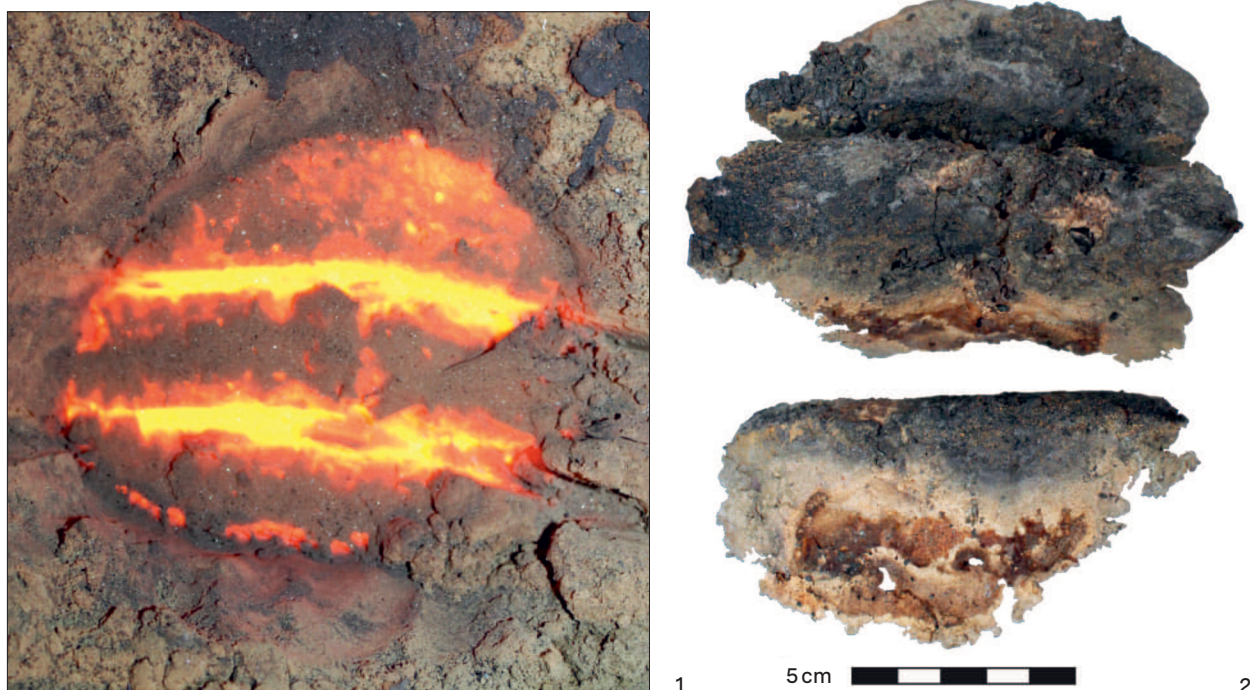


Fig. 12 Experimental archaeological ingot cut into pieces in a melted state (1), and solidified as »fragments« (2). Experiments by Cs. Bíró and J. G. Tarbay. – (Photos J. G. Tarbay).

In the West Hungarian Ha B1 hoards of mixed composition, they usually contain objects with different intensities of use, or even the complete absence of any use (as-casts, defective castings, unfinished products). Such a mixed pattern may indicate that the objects with different life-paths seen in the deposited hoards were not broken at the same time⁶⁰. As-castings and defective castings could have been broken up in the workshop; damage to used objects could have occurred at a time closer to the hoarding event probably after a longer period of use, or re-use by one or several people. Scenarios of why and when breakage in the Bronze Age could have occurred on one object beyond using conventional means of interpreting metal fragments, and the temporality of use-wear traces are worth considering, and we will provide some examples of this below.

All bronze castings are made by fragmentation. This means the breakage of the ingots, by-products, even used finished products for melting in the cru-

cible. The fragmentation of ingots and other objects used as raw materials (recollected by-products, partitioned bronzes) is typical object treatment in a foundry, as making large objects smaller is the only way to use them for casting. Thanks to advances in plano-convex ingot research, it is now clear how this process could have been done. Ingots are cut into pieces in a molten or semi-molten state seconds after casting (**fig. 12**) or broken into pieces by hammers in a re-heated state⁶¹. Breakage occurs when the different sized casting jets and risers are removed from the casts. Depending on their size and shape, these can be removed with the aid of different tools, preferably in a heated state (**fig. 13**)⁶². These usually do not affect the functionality of the objects but manifest themselves as a breakage.

Most of the Carpathian hoards contain fragments of objects without their missing parts. They cannot be refitted with objects from the same assemblage. One explanation for the large number of missing parts is

⁶⁰ Tarbay 2022a, 137-148.

⁶¹ Modl 2010; Nessel 2014; Modl 2019.

⁶² Ferenczy 1976, 246; Jantzen 2008, 226-227.



Fig. 13 Hilt of the sword from Veszprém-Arany János utca. Four impacts from both sides which may have been caused by a chisel. Laczkó Dezső Museum, Veszprém. – (Photos J. G. Tarbay).

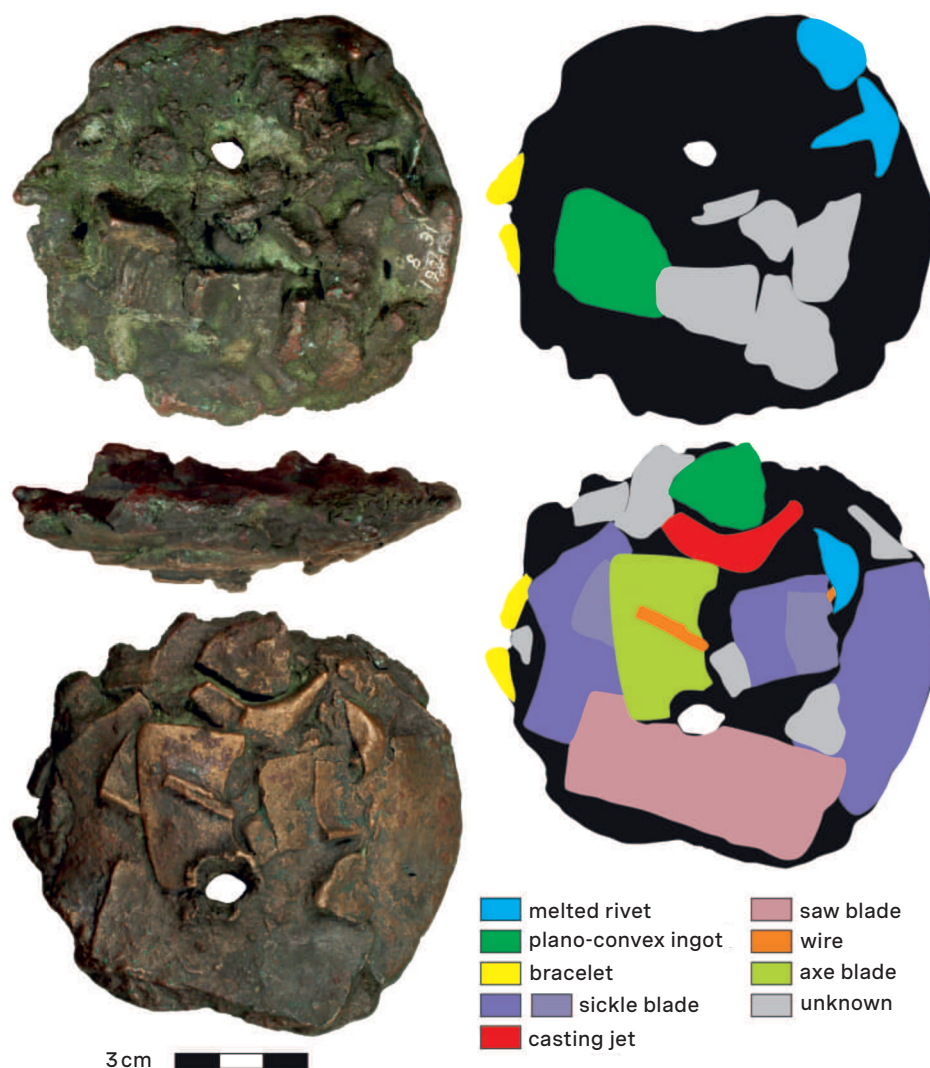
that they may have been recycled⁶³. There is well-known archaeological evidence of metal recycling in the Carpathian Basin provided by Amália Mozsolics in 1981⁶⁴, who introduced special plano-convex ingots from the Bodrogkeresztúr hoard (Borsod-Abaúj-Zemplén County/HU), some of which consist of melted small fragments of finished products fused together probably in an open mould filled with fluid metal. The ingot, re-introduced here as an example, shows how small fragments were collected for such activities. On the convex sides of the ingot, various

fragmented objects can be seen based on their outlines and cross section, such as a saw fragment, an axe blade fragment, different types of sickle blade fragments, the edge of a partitioned ingot or droplet, a melted rivet, a melted wire fragment, and a melted bracelet. On the plano side, a melted large rivet is visible along with a plano-convex ingot fragment. They were carefully arranged inside a shallow open mould, probably carved into the berm of the workshop, and in a molten state pierced through, either to test the cooling of the material or to remove the

⁶³ Delfino 2014.

⁶⁴ Mozsolics 1981.

Fig. 14 An ingot consisting of recycled fragments from the Bodrogkeresztúr hoard. Hungarian National Museum, Budapest. – (Photos J. G. Tarbay).



ingot from the mould (**fig. 14**)⁶⁵. Bodrogkeresztúr is not the only evidence of this practice, as Carol Kacsó has also enriched the number of known Carpathian examples with those from Romania, Hungary, and Serbia, proving that fragment recycling was not an isolated phenomenon⁶⁶. The existence of these ingots and their analogues suggests that hoards with a strong metallurgical character, the so-called workshop hoards, consisting of ingots, by-products, and specialist tools⁶⁷, may be interpreted as being raw materials waiting to be recycled when containing small fragments of objects.

Technological production defects can cause phenomena like fragmentation. Characteristics of this are misrun defects and especially cases when an object is cast incompletely, which occurs for dif-

ferent reasons when the metal flowing through the channels, does not fuse properly and is unable to fill the cavity of the casting mould, leaving incomplete, round-edged surfaces in the casting⁶⁸. While misruns are typically small gaps in the castings and therefore easier to differentiate from fragmentation, when an object is cast incompletely, to a lesser or greater extent parts of it are usually missing. Whenever possible, Bronze Age people further manufactured these objects during the post-casting treatment phase to make them functional. When they were unsuitable for performing their function, for instance, if functionally important parts of them were missing, objects were likely to be recycled for re-melting; some of them ended up in hoards. Macroscopically, these phenomena are easy to identify

⁶⁵ Mozsolics 1981.

⁶⁶ See Kacsó 2013, 228–229. Further example: Tarbay 2022a, pl. 24.

⁶⁷ Mozsolics 1984, 43–46. 55; 1987, 95.

⁶⁸ See causes and remedies Mozsolics 1984, pl. 13, 1; Ó Faoláin/Northover 1998, 73; Mödler 2011b, 13; Atlas of Casting Defects 2017, 35; Tarbay 2022a, pls 56 C; 57 D; Tarbay 2024.

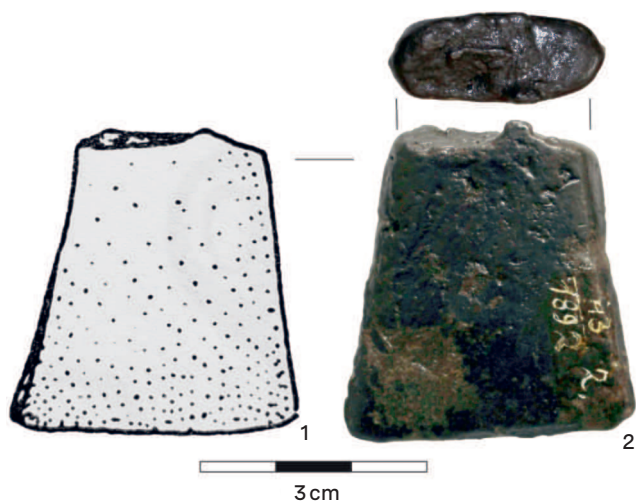


Fig. 15 An incomplete cast socketed axe from the Ha B1 hoard found at Szentcs-Nagyhegy I: **1** Drawing depicting the object as a fragment. – **2** Photography of the object, showing rounded edges typical of incomplete casts. – (1 after Kemenczei 1996, fig. 33, 2; 2 photo J. G. Tarbay).



Fig. 16 The spearhead from Balassagyarmat. Hungarian National Museum, Budapest. – (Photos J. G. Tarbay).



Fig. 17 Repaired bronze cup (1–2) from Solt (Bács-Kiskun County/HU). – (Photos J. G. Tarbay).

by the round-edge surfaces, but it is near impossible to identify them in the black-and-white drawings of old literature. Like the incompletely cast socketed axe blade from the Szentcs-Nagyhegy hoard I (Csongrád County/HU) with a missing upper part, published as a »blade fragment of an axe«, but in fact is an incomplete casting showing typical traces of this defect (**fig. 15**)⁶⁹.

Objects could have been damaged or broken during use; the most well-researched examples have been described in the case of Late Bronze Age spearheads and metal vessels. For spearheads, it is common for them to be re-sharpened and, in certain cases, completely re-shaped. The tip is one of the most

⁶⁹ Kemenczei 1996, 61 pl. 33, 2.

Fig. 18 The knife blade from Lovasberény. Szent István Király Museum, Székesfehérvár. – (Photos J. G. Tarbay).



active points of this weapon, which must penetrate through several layers of metal or organic armour, tissue of another warrior or hunted animals covered in thick layers of skin and fur. Missed combat hits that are deflected by shields or poorly thrown javelins that impact in the ground can further damage these parts and potentially contribute to their final damage. Bronze Age metalworkers therefore redesigned these weapons at a certain point in their use-life. The Balassagyarmat (Nógrád County/HU)⁷⁰ spearhead is a good example. The initial blade shape of this spearhead was flame-shaped like the rest of the spearheads with stepped blades. At one stage of its use-life, a larger part of the tip has been removed, re-hammered and filed into a lozenge-shaped form. This modification may have been carried out either by the craftsperson or, alternatively, by the finder of the hoard, instinctively reproducing a Bronze Age practice (fig. 16).

The use and repair of the prestigious Late Bronze Age metal vessels also deserves special attention. This artefact category and their repairs have been well-discussed in the literature⁷¹. Damaged metal vessels, usually cauldrons, situla and cups, show cracks along their supposedly most active parts and

the bottom, which may have been in contact with the ground or with fire if they were used for cooking or heating liquids. Cracked and broken parts were usually removed, or additional patches of sheet metal were affixed with flat-hammered pegs (fig. 17). The sheet metal used for repairs was not always a completely newly made product; it could have been recycled parts of other metal vessels, or even the same sheet could have been used as small patches for the vessel. Metal vessels, elements of an elite banquet set, should have had a complex use-life and circulated as intact objects, and later as repaired objects, until they became part of various hoards. While others were dismantled, cut and broken into pieces to become raw materials or selected for hoards with a mixed composition. Even as fragments, a metal vessel was able to circulate for a long time, as proven by a Hajdúböszörmény style sheet disc from the Early Iron Age hoard found at Biharugra (Békés County/HU)⁷².

Fragments can be reborn as other objects with completely different functions. A fine example is the »knife blade« from the Lovasberény hoard (Fejér County/HU) noted by Amália Mozsolics, which was made from a broken blade of a flange-sickle (fig. 18)⁷³. The end of the fragment was filed, show-

⁷⁰ See Kemenczei 1984, 145 pl. 115b, 3; Mozsolics 1985, 90; Tarbay 2018, 574–576 pl. 8, 2.

⁷¹ Patay 1990, 10–11; Gogáltn 1993.

⁷² Tarbay 2022b, 19–20 fig. 15.

⁷³ Mozsolics 1985, 18. 145.



Fig. 19 Recycled belt parts from Esztergom (Komárom-Esztergom County/HU). Balassa Bálint Museum, Esztergom. – (Photos J. G. Tarbay).

ing characteristic traces of this process, and an additional peg was attached to this part to hold the blade in the organic hilt. Similar modified sickle fragments were observed in German Late Bronze Age objects⁷⁴. There are also countless broken socketed axes with missing blades that were eventually used as hammers by metalworkers⁷⁵. This kind of re-use was not limited to tools; objects with a supposedly higher prestige could also be subjected to recycling. Such are the large, wide and complex sheet metal belts decorated with symbols of earthly and transcendent power, such as spoke wheels and celestial bodies. It is hard to argue against the idea that they were prestige objects of the Bz D–Ha A1 phases, yet some of these objects at the end of their life cycle, and after several repairs, became something else. Small belt parts, cut into pieces were transformed into various types of small jewellery, usually funnel-shaped pendants (**fig. 19**) or small decorative discs. At this point the belts served only as raw sheet-metal, which can

be supported by the fact that jewellery no longer respected the original ornaments and motifs. A fine example of this treatment of metal belts can be seen in Late Bronze Age Hungarian, Romanian and Czech artefacts⁷⁶.

Naturally, there are fragments that may have been created for the hoarding process and had a symbolic meaning for those who carried out the deposition. The excavations of the lavish elite hoards from Pázmándfalu (Győr-Moson-Sopron County/HU) showed that fragments of the same short sword (**fig. 20**) and parts of the melted and intentionally damaged cuirass were intentionally divided between the two hoards (Hoards I and II). The objects from the Pázmándfalu hoards were most likely burned in a pyre, as their melted surfaces suggest; the fragmentation process may have occurred in the framework of another rite, perhaps a burial, and it had a primary significance there. During the act of hoarding, their state as fragments could matter, which was emphasised by the separation of the same objects in two hoards⁷⁷.

The »miniature hoards«, or combinations of objects in metal hoards that can be found between Great Britain and the Carpathian Basin consist of another group of manipulation categories that research associates with hoarding. An object combination can be anything from interlocking rings to socketed axes filled with fragments of objects or even organic materials. Fragmented objects are frequently combined with each other, in a way that they are difficult to remove. In this manner, the object combination from the Oltárc Márki Hill (Zala County/HU) hoard is an extraordinary find, and the result of a complex object manipulation. Its central object is a fragmented axe filled with knives and one broken spearhead (**fig. 21**). The lower part of the broken axe near the missing blade has been hammered from the sides to fix these objects, which means that it was important that the fragments could not be separated once they were united⁷⁸.

⁷⁴ Hohlbein 2016, 183–185.

⁷⁵ Wanzek 1992, 268–269; Gogâltan 2005, 369–370 pl. 16.

⁷⁶ See with further literature Tarbay 2022a, 100–101.

⁷⁷ V. Szabó 2019, 60–71 fig. 47.

⁷⁸ Hansen 1996–1998; Turner 1998, 88–89. 115–116; Maraszek 2006, 274; Tarbay 2017b, 74. 84 fig. 5; Dietrich/Mörtz 2019; Tarbay 2022a, 121–122.



Fig. 20 The fragmented sword from Pázmándfalu Hoards I-II. ELTE Institute of Archaeological Sciences, Budapest. – (Photos J. G. Tarbay).



Fig. 21 Socketed axe with fragments of three knives and a fragmented spearhead from Oltárc-Márki Hill. Göcseji Museum, Zalaegerszeg. – (Photos L. É. Horváth).

Finally, it is worth paying attention to intact objects because a hoard consisting of partially or completely intact objects does not mean that the deposited objects were not broken. Late Bronze Age artefacts are typically composite objects. Tools have wooden shafts, hilt plates, and organic pegs. It cannot be ruled out that the breakage itself was not made on the metal part but on the organic material, like the handle of a socketed axe. These are, of course, hard to detect due to the preservation of organic materials. But breakage may be visible in how used or heavily used objects within one hoard were positioned if they could not fit into their position with a handle. Used and heavily used objects like axes, spearheads and sickles in an intact or fragmented state deposited inside vessels are likely to have had their organic

parts dismantled, too. Whenever organic materials are found preserved, they may provide further information. Small »intact« items of metal jewellery are usually parts that constituted one object, like smaller or larger decorative discs and pendants that were attached to textile or leather clothes, caps, and belts. A fine example is the composite belt from Ilija-Sitno (Banská Bystrica Region/SK) where small decorative discs, annular rings and pendants were part of one leather belt⁷⁹. When only a few of these are found in a hoard, it could mean an intentionally torn piece of clothing was placed along with the hoarded objects. The damage was not done to the small metal parts but to the cloth itself. Dismantling a chariot for hoarding follows the same concept. Chariot or

wagon parts appear in Carpathian hoards, usually with a mixed composition. A horse-drawn vehicle is essentially wood with metal parts, some functional, but most of them serving as decoration⁸⁰. The intentional destruction of a chariot or wagon involves, for the most part, disassembling or chopping up the wooden parts and the removal of the metal parts. Axle caps, linchpins, hubs, and other small decorative elements can be intact or fragmented. An intact axle cap was found in the Várvölgy-Nagy-Lázhegy hoard, and intentionally damaged wagon parts in the Szentgyörgyvár-Felsőmánd (Zala County/HU) hoard⁸¹. Both were from the same period of Transdanubian Urnfield culture, and excavated not far from each other.

An Effort for Data Cleaning: Broken Transdanubian Swords

Recently, an attempt has been made to move forward in the direction of characterising the use-wear and fragmentation patterns of Late Bronze Age weaponry from West Hungary by using comprehensive source-critical re-analysis within the framework of the research programme titled »The Technology, Use and Manipulation of Weapons from Late Bronze Age Transdanubia«⁸². Here we introduce some preliminary results, which we intend to refine, to show how we can handle old and new data in a regional-scale analysis. The chronological background of the analysis was the time between the Reinecke Bz B2 and Ha B2 phases, and the materials studied are swords from hoards, burials, settlements, wetland (mainly from the River Danube) areas, and of course stray finds. Here, use-wear patterns will be discussed in the context of the entire body of material, but for illustrating fragmentation, our example will only be given from Ha A1–Ha B2 hoards, as it is the most representative group.

Between 2020 and 2023, a total of 314 swords⁸³ were re-studied using use-wear analysis which was supplemented with micrographs to record each instance of micro-damage and photographs to record macro traces. The interpretation of use-wear data relied on the personal experience of the author and on relevant use-wear and experimental archaeological literature on the sword combat traces⁸⁴. Unfortunately, out of the 314 swords, 159 had been cleaned by surface destructive conservation techniques, thereby making observations regarding fragmentation and use uncertain in these cases.

Modern use-wear was detected on approximately 16 % (51 swords) of the 314 weapons. Of these 51 swords, 40 also showed traces of prehistoric use, mainly in the form of macro damage (e.g. re-sharpened blades, worn edge-damage etc.). Modern micro-damage, in order of frequency, were dents, notches (U and V-shaped notches), bows, tip damage, curling and flattening. All typical damage to a sword occurs dur-

⁷⁹ Ožd'áni/Žerbák 2017.

⁸⁰ Pankau 2024.

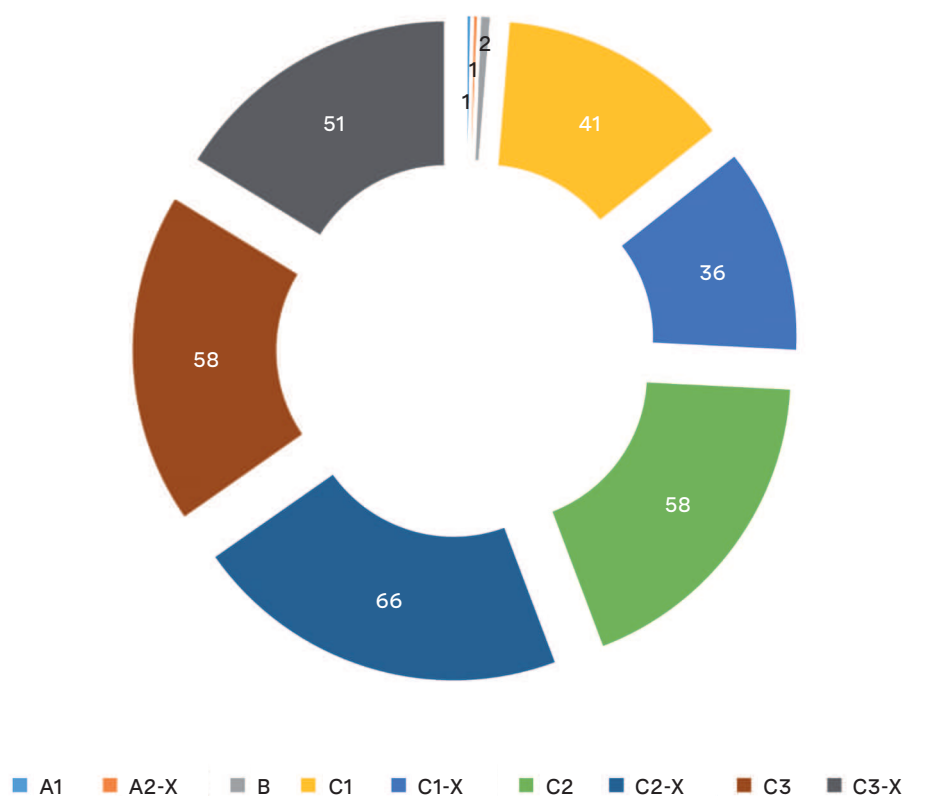
⁸¹ Müller 2006, 235 fig. 4; Tarbay/Havasi 2019.

⁸² Tarbay 2022c.

⁸³ A total of 422 swords were found in the Transdanubian region; 314 swords were available for study in museum collections between 2020 and 2024. The number of objects studied was influenced by losses or by the fact that some objects were not available for research.

⁸⁴ Bridgford 2000; Gentile/van Gijn 2019; Hermann et al. 2020a; 2020b.

Fig. 22 Use-wear classification of Late Bronze Age swords from West Hungary. – (Graphics J. G. Tarbay).



ing combat, and is generally edge-on-edge contact or flat-on-edge contact. The presence of this type of damage suggests that these weapons were either used for fencing between the 19th and 21st centuries or their edges were damaged by modern bladed objects, and left traces that look like Bronze Age sword fighting damage and archaeological experiments that intend to create edge-on-edge damage during combat. The exceptions are perhaps dents, which, as pointed out earlier, could have been caused by other circumstances. In our experience, the »relatively low« instances of modern combat damage are due to the small number of intact West Hungarian swords (except for river finds). The situation is much more dire in the Eastern Carpathian Basin of the same era because complete swords are frequently discovered in this area and are more likely to be tried out by the finders as pointed out by Krasznokvajda and Podhering.

From a technological perspective, the Transdanubian swords show homogeneous tendencies. Ascasts (Type A1), defective products (Type A2), and unfinished products (Type B) are extremely rare among them. These finds usually originate from hoards, essentially ones with a more pronounced metallurgical character. Considering the rest of the techno-types such as C1 (finished products, use-wear

traces not observable), C2 (finished, used products), and C3 (finished, heavily used products), used and heavily used objects outnumbered those that were finished products but showed no wear traces as a result of different reasons (unused, traces were removed prior to deposition, traces were worn away, corrosion, conservation, etc.). It appears that essentially finished swords were deposited in different contexts. Many of them are also used or heavily used when placed in the graves, hoards, rivers, etc. This trend can also be seen if we consider objects marked with an X (C1-X, C2-X, C3-X) that indicates the use of surface destructive conservation techniques, thereby making them unsuitable for reliable use-wear analysis (**fig. 22**). The number of finished products and the presence of used and heavily used swords show that Transdanubian Late Bronze Age swords were not only real combat weapons, and the implication of this suggests that they were probably used over a longer period. For the heavily used category (C3), no significant traces of alteration were observable, however heavy abrasion traces on the blade and hilt areas, edge re-sharpening, repairs of older dents, notches and bows can be seen.

To interpret fragmentation patterns, we must also consider the reliability those artefacts that have

not been cleaned by destructive conservation techniques (marked with X) in the past or whose original state was well-documented enough by excavation and/or photography (e. g. Pázmándfalu) to exclude the chance of modern breaks (**fig. 23A**). Of the 314 swords, 57 had some kind of modern alteration or breakage, such as soldering, filling, (steel) tool impact, and bending. This included 17 hoarded swords, of which 6 had modern damage. The source-critical approach greatly reduces the number of objects available for analysis, which is not favourable for statistics, however for other object types in larger numbers, such as axes or sickles, it would probably still result in a representative number of objects.

In hoards, typically finished products without observable use-wear traces, as well as used and heavily used swords, were broken in this region. No complete swords have been found except for the lost swords from the Celldömölk-Sághegy Hoard II (Vas County/HU), which even have scabbards. As these are known only from archival photographs, they can be treated as uncertain according to the rules of analysis⁸⁵. Objects that belong to the other three almost non-existent categories (Types A1–A2, B) are also all broken. The sword fragment from Várvölgy-Nagy-Lázhegy (Zala County/HU) should be highlighted⁸⁶, which is in a way analogous to the incomplete cast socketed axe from Szentes-Nagyhegy I (Csongrád County/HU). One shoulder of the hilt is missing, mainly due to a casting defect.

It seems that the trend of sword deposition in West Hungary between the Ha A1 and Ha B2 is that swords were placed on a hoard in a manipulated state, usually broken. Most breakages were intentional, and the treatment of this weapon type rarely includes extra manipulations beyond breakage. We found little evidence for use-wear breakage, except for the Jánossomorja sword⁸⁷, whose peg holes may have been damaged during use. The hilt fragments were generally missing their pegs, and no wooden or bone hilt plates were identified in the hoarded mate-

rial. The organic parts had either decomposed (wooden pegs, wooden hilt plates) or had been removed from the weapons. The removal of organic and metal parts may be indicated by the partial absence of metal rivets on broken hilt parts (e. g. Pölöske, Zala County/HU). There are also certain breakage types, like the U-shaped bent and broken sword from Tab (Somogy County/HU)⁸⁸ with missing hilt parts. This damage could not have been done without removing or damaging the bone, wood or bronze hilt plates of the sword.

The resulting pattern shows typical and specific types of breakage and damage. In most of these hoards with mixed composition, blade fragments are often sorted into essentially small fragments from the blade or fragments from the area of the tip. Breakage shapes from the hilt area also tend to be common. One may argue that we can see a pattern here of a recurring theme where the shape of the fragment matters to the depositors, and there are a handful of individual cases when special manipulations have happened, such as in the Pázmándfalu and Tatabánya A–B funerary hoards, where the swords were broken into pieces in a melted state and placed in special positions in these elite hoards that celebrated warrior identity⁸⁹. This is observable between Ha A1 and Ha B1 when blade fragments are taken into consideration. In any case, the amount of data should be increased to provide clear evidence of this. Other causes should also be considered, for example, when a sword is broken into pieces, it is more likely that a blade fragment is created, thus more of them are available, and therefore more likely to end up in hoards. It is also possible that the pattern sword fragmentation may also correlate with the general fragmentation pattern of the assemblage. It can be seen that in hoards with a mixed composition, they receive no special treatment than other object groups⁹⁰. Some of the small-sized fragments tend to appear in hoards with strong metallurgical characteristics, such as Nagydobsza, Bolhás⁹¹, and Csabdi⁹².

⁸⁵ Lázár 1941, 373–374 fig. 3.

⁸⁶ Müller 2011, 215 fig. 5, 26.

⁸⁷ Kemenczei 1988, 22 pl. 6, 65.

⁸⁸ Kemenczei 1988, pl. 36.328.

⁸⁹ V. Szabó 2019, 147–155; Tarbay 2019.

⁹⁰ Tarbay 2021b.

⁹¹ Unpublished.

⁹² Mozsolics 1985, pl. 248, 13; Tarbay 2015–2016, 116 fig. 11, 1–3.

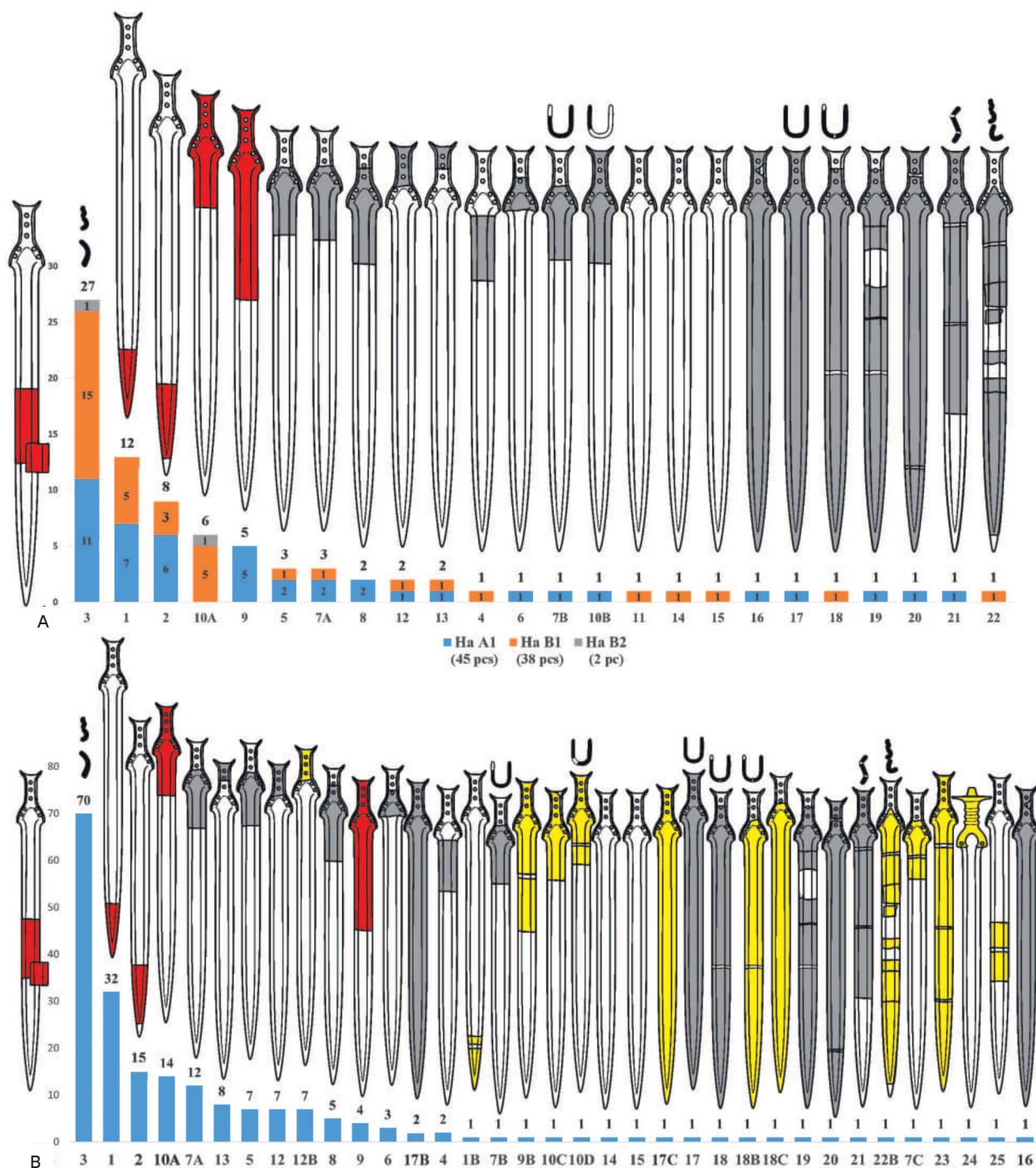


Fig. 23 Fragmentation shapes of Late Bronze Age Transdanubian hoarded swords (A-B). – (Graphics J. G. Tarbay).

In these cases, the possibility should not be excluded that these swords were already considered as raw materials when they were selected for hoarding.

If all uncertain cases are included, like over-conserved swords (X) on which observation of fragmentation is always doubtful, modern breakage without proper interpretation, and swords that can only be studied based on data from the literature, the fol-

lowing trends can be seen (fig. 23B). Obviously, the number of objects increases, which is favourable for statistics. We can also speculate that probably not all of the over-restored swords were damaged in modern times, but of course how many of them were broken by Bronze Age people is unknown. The most common fragmentation shape is again sword blade fragments. This is followed by the tip fragments rather than the

bladed handle fragments, which seems to be more common here; however, its sub-variant became less common. We can also observe the rearrangement of fragmentation shapes in order of frequency. In addition, many individual breakage forms also appear. Modern breaks essentially create sub-variants of certain fragmentation shapes when they are not refitted along their modern breakage surfaces (e.g. Type 3 to Type 25) or distort the fragmentation pattern of weapons broken into several small pieces. In

conclusion, there is overlap between the two sets, but the results are not the same, and misinterpretation of the data is quite possible if a source-critical approach to the material is not applied. In the case of the more reliable pattern, there is no doubt that certainty also entails a great loss of data, but in return, the pattern is closer to the »reality« of the hoarding state and it can be extended, refined and built on with new finds.

Conclusion

There are several scenarios why Bronze Age metal objects may be used or fragmented, and whether this happened in prehistory or between the 19th and 21st centuries following their discovery. In this essay, selected examples from the Carpathian Basin, mainly from Hungary, were presented, to give a sense of the diversity of the material. With the knowledge accumulated by the past generation of scholars, new technology and functional-orientated questions, and an advanced methodology, the study of old and new material in museum collections has a huge potential, especially with big data processing. At the same time, the data should be revitalised, and especially in the case of old material, a considerable revision of all sources is needed for a correct interpretation

and data gathering. At present, relevant conclusions can be drawn from new finds, single re-analysed old objects, or types of artefacts or assemblages. For the development of large regional or pan-European synthesis, in our opinion, a data revision is needed, which means re-examining all the existing material found so far by following strong methodological and documentation protocols. This will be time-consuming work, but as the example of Late Bronze Age swords from Western Hungary has shown, a re-analysis of formerly found objects' use-wear and fragmentation patterns with a source-critical perspective contributes to obtaining a more accurate picture of both Late Bronze Age phenomena.

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Fragmentation Patterns in the Eastern Carpathian Basin during the Bronze Age

ABSTRACT

The Eastern Carpathian Basin represented a unique region with a diverse and developed metallurgy. During the Early Bronze Age the largely clean hoards didn't show any traces of deliberate manipulation. The Middle Bronze Age finds stood out mostly by their elaborate metalwork and sophisticated decoration. Besides the weight and the typological distribution of the Late Bronze Age assemblages, the fragmentation was one of the most important characteristics of the finds. In the later stages of the Late Bronze Age the structure of the finds changed again, which had an impact on fragmentation practices. It seems that the pattern of fragmentation changed according to different chronological periods and regions. Intriguing questions arise when observing the hoards over a longer period of time. Knowing that sharp chronological limits are impossible to be drawn, one can ask whether the shift between different hoarding models can be emphasized by specific finds. Was the continuous evolution of the hoards cut short by »threshold discoveries« which point towards new hoarding practices? A significant issue of the voluntary breakage is the problem of the »missing object«, which never obtained a permanent place in the structure of these finds. Is their absence a coincidence, or can they somehow be integrated in the general patterns of metal fragmentation? The scale and the degree of damage of the missing bits varied according to different chronological periods, sometimes giving us a double hoarding image, in which the existing and missing parts could have played different roles as well. Thus, the paper provides a basic diachronic characterisation of this phenomenon, and seeks answers to questions regarding the geographically and chronologically defined fragmentation and whether its cause can be seen as a social trend and as such an act of ritual damage.

KEYWORDS

Eastern Carpathian Basin | Bronze Age | fragmentation | hoarding | hoard structure | chronology

The most outstanding legacy of the Carpathian Basin's Bronze Age is represented by the bronze hoards, which, due to their opulence and variety, play a prominent role within the discoveries of the period. During almost the entire Romanian Bronze Age, the presence of fragmentation within the bronze hoards is more than evident. Its intensity varies according to the structure of the finds, to their chronological position, or even to their geographical distribution.

The main objective of the following paper is to trace the evolution of this specific practice over a longer period of time and across several geographical regions, thus trying to obtain a general picture of trends. We are aware of the difficulties and obstacles regarding such an endeavour. First of all, the find circumstances of many hoards are questionable, thus the exact number of artefacts, the structure of the assemblage, and furthermore the modern manipu-

lation of the artefacts is ambiguous and problematic¹. Secondly, the analysis of fragmentation patterns and damage marks based on publications is a major setback, because the uncertain information is not filtered and the documentation in publications is often insufficient. Also, the very specific details necessary for such an analysis, such as use-wear marks, blow marks, manipulation marks, traces of fire, chemical composition, are often missing or neglected. In spite of all this, the large number of hoards and artefacts, the diverse character of the material, the extended

size of the region under scrutiny here with its differentiated hoarding patterns, serve as a good database for outlining the major characteristics and several specific aspects of the fragmentation practice.

In the first half of the paper I will take a look at the fragmentation practices of the hoards from the Eastern Carpathian Basin, from the Early Bronze Age to the evolved stages of the Late Bronze Age². In the second part, certain possibilities of approach will be outlined through which this very specific practice could be better understood.

Chronological and Spatial Patterns

As far as research history is concerned, Romanian researchers have paid less attention to the topic of fragmentation than their western colleagues. Compared to the European literature, which is dominated by different theories regarding the destruction and manipulation of the bronze artefacts³, the Romanian archaeological literature is extremely poor⁴. The first paper which deals exclusively with this topic, namely the weight ratios of the golden rings from the Cugir hoard (Alba County/RO) was published only in 2010⁵. This is why the detailed and sometimes uncommon studies on different fragmentation topics are justified, giving us an insight into a very specific custom.

The characteristics of the Transylvanian metal fragmentation can be stressed by the hoarding patterns of the succeeding chronological periods. From the Early Bronze Age (c. 2800–2000 BC) we can name only few, mostly »clean« hoards with a total lack of fragmentation. The finds from Periam (Timiș County/RO)⁶ and Sarmizegetusa II (Hunedoara County/RO)⁷ are composed exclusively of buttons, the ones from Sânzieni (Covasna County/RO)⁸ and Vâlcele I (Cluj County/RO)⁹ are entirely dominated by hammer-axes. Only in the hoard from Vârghiș (Covasna County/RO)¹⁰ can one find two spiral bracelets and two hammer-axes buried together. Regarding this later assemblage, we have some information about

1 Regarding the difficulties and possibilities offered by modern manipulation, see Skinner 2009; Tarbay 2015b, 46; 2017, 79–80; 2022c, 65–66. 68.

2 For the chronological periodisation of Transylvania, see Ciugudean 2010a; 2012; Ciugudean/Quinn 2015, fig. 9; Gogâltan 2015, with previous literature; Ciugudean 2021.

3 For the »founder's or scrap hoard« theory from the most important studies, see von Brunn 1968; 1981, 120–122. 127–129; Eogan 1983; Rittershofer 1983; Huth 1997, 178–184; Görmer 2006, 289–297; Huth 2008; Wiseman 2018; Huth 2024. For the »pre-monetary« theory, see Primas 1986, 35–41; 2008, 163–167; Sommerfeld 1987, 240–242; 1994, 37–61; Lenerz-De Wilde 1995, 229–331; Ialongo 2019; Ialongo/Rahmstorf 2019; Lago 2020; Ilon 2022. For the »ritual or symbolic fragmentation« theory, see Hansen 1994, 326–366 figs 206. 211–212; Nebelsick 1997, 36–41; 2000, 163–167; Kristiansen 2002, 319–332; Brück 2006; Maraszek 2006, 248–261; Quilliec 2008, 70–75; Hansen 2013a, 179–180; Mörtz 2013; Dietrich 2014; Brück 2016; Hansen 2016, 199–201; Knight 2019; 2020; 2023; Sörman 2024. Regarding the research history of fragmentation theory, see Knight 2022, 2–9; Chapman 2024.

4 Nistor/Vulpe 1970, 629–630; 1974, 14–15; Motzoi-Chicideanu/Iuga 1995, 157; Chidioșan/Soroceanu 1995, 180; Kacsó 1995c, 135; Motzoi-Chicideanu/Lichiardopol 1995, 270–271; Hänsel 2005; Bejinariu 2007, 71–75; Bratu 2009, 120–126; Ciugudean et al. 2006a, 46; 2006b, 101; Ciugudean/Ciută 2008, 351–353; Ciugudean et al. 2008, 39–41; 2010, 39–40; Rezi 2011 (first general overview of a specific region from Romania); Vieru 2013, 209–219; Marta 2015, 272–275 pls 4–5; Bejinariu/Henț 2019, 96–97; Popescu 2023.

5 Ciugudean 2010b.

6 Roska 1942, fig. 265.

7 Soroceanu 2012, 99–100 pl. 30, 6–25.

8 Soroceanu 2012, 95–97 pl. 28.

9 Soroceanu 2012, 109–114 pls 37–43, 1–2. Recently, the very specific metal artefacts from Transylvania, namely the Baniabac type shaft-hole axes, have been dated before the Early Bronze Age, implicitly before the 3rd millennium BC. See Gogâltan 2013, 53–54; Dani 2013, 203–204 fig. 10; Szevérenyi 2013, 666.

10 Dénes/Szabó 1998, 89–110 figs 4–6.

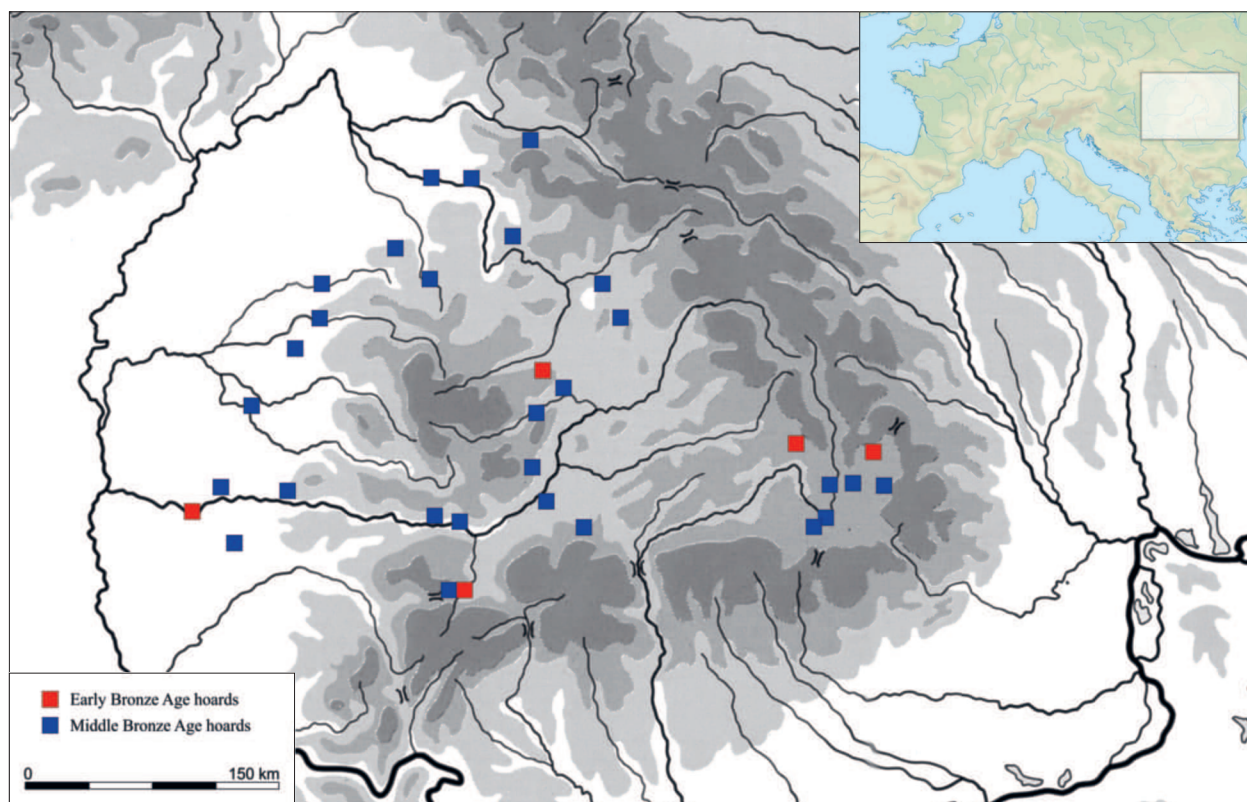


Fig. 1 The geographical distribution of the Early and Middle Bronze Age hoards from the Eastern Carpathian Basin. – (List of hoards after Soroceanu 2012, 17–126; map B. Rezi).

the manipulation of the artefacts. One of the shaft-hole axes bears slight hammer traces on its surface, the second one has a sharpened and chipped cutting edge¹¹, most probably after a normal but demanding use. The same can be observed on several axes from Vâlcele I¹². Regardless of the type, each object from this period is intact, without the slightest trace of intentional fragmentation. Due to their small number, the geographical distribution of the finds is not relevant (**fig. 1**).

The Middle Bronze Age hoards (c. 2000–1450 BC) of the Carpathian Basin can be separated into two major groups based on their structure: west of the Danube, the Tolnanémedi type assemblages are present, characterised by the predominance of or-

naments, such as pendants, spiral tubules, buttons, neck and arm ornaments¹³. In the eastern half of the Carpathian Basin, mainly in the Upper Tisza region, the Hajdúsámson type hoards exceed mostly by their decoration, generally consisting of prestige items, whose individual character points towards the personal possession of sole warriors¹⁴. The leading artefact type is represented by the battle-axe with its different variants, namely disc-butted axes, ridged-axes, and tubular shaft-hole axes. Among weapons, the spearheads and swords play a secondary role. During the second phase of the Middle Bronze Age, around 1700–1600 BC, the first obvious weapon-like long blades, namely the swords, appear. Due to their casting techniques and decoration these weapons rep-

¹¹ Dénes/Szabó 1998, 91.

¹² Soroceanu 2012, pls 37, 1–2; 38, 2–3; 39, 3; 40, 1; 41, 3; 42, 1–2.

¹³ Hansen 2005, 218–219; Kiss 2009, 328–329. 332–333; 2012, 134–150; Honti/Kiss 2013, 750–752.

¹⁴ David 1993; 2002, 399–402. 406–410; Hansen 2005, 214–215; Vachta 2008, 75–85; David 2010; Dani et al. 2016, 233; Dietrich/Mörtz 2019, 282.

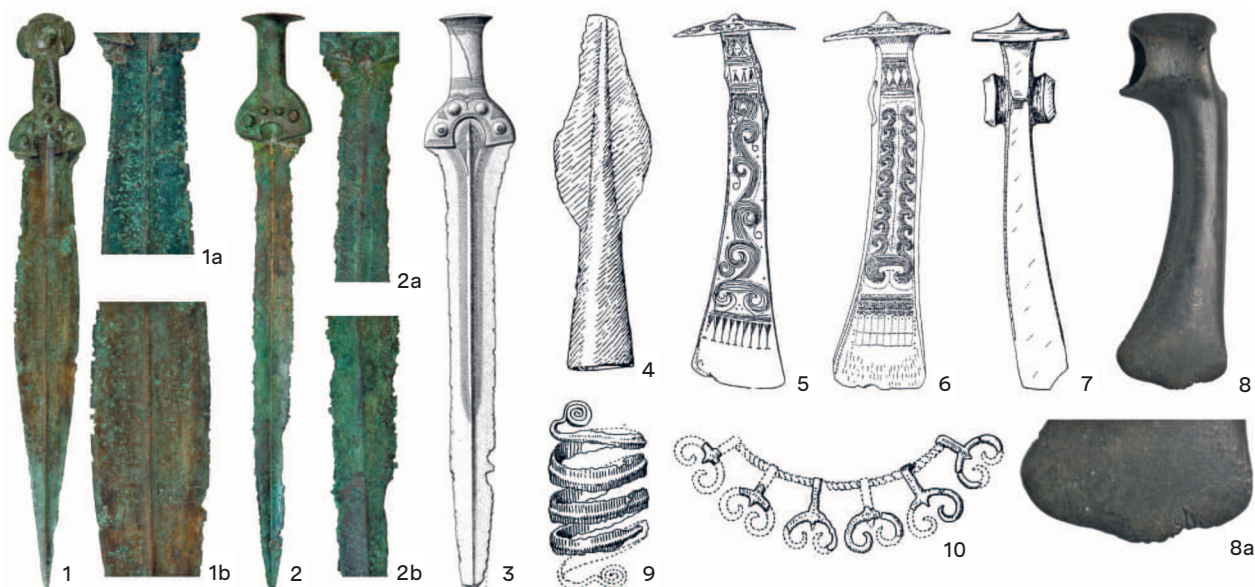


Fig. 2 Deterioration marks on selected Middle Bronze Age artefacts. – 1–2, 5 Apa. – 3 Oradea III. – 4 Păuliș. – 6, 9–10 Săpânța. – 7 Roșiori. – 8 Covasna. – (Photos 1–2 T. Soroceanu; 3 after Bader 1991, pl. 6, 27; 4 after David 2002, pl. 123, 4; 5 after Popescu 1937–1940, pl. 3; 6–7, 9–10 after Popescu/Rusu 1966, figs R8a, 1; R8b, 6–7; 8 after Soroceanu 2012, pl. 10, 6b). – Not to scale.

resented the finest metallurgical asset of the period. A considerable amount of pendants, bracelets, pins, and buttons were also deposited¹⁵. Tools are largely missing. The presence of the raw material is also very unusual. From the Transylvanian Middle Bronze Age only the hoards from Roșiori (Bihor County/RO)¹⁶, Ighiel (Alba County/RO)¹⁷ and the one from the former Turda District (Cluj County/RO)¹⁸ contain in-got fragments. The hoards from western Romania are present mostly around the Western Carpathian Mountains, their Central and Eastern Transylvanian presence is not common (see **fig. 1**)¹⁹. Fragmentation cannot be considered a general characteristic of the finds or of the period, even if one includes the isolated finds as well²⁰. The deliberate, destructive manipulation is inexistent, although we can name several hoards, where broken objects are present. These damage marks can be the result of an intensive wear, but are more likely to have occurred after repeated sharpening. The swords from Apa (Satu Mare Coun-

ty/RO)²¹ and Oradea III (Bihor County/RO)²², the blades of the spearheads from Păuliș (Arad County/RO)²³ and Vărșand I (Arad County/RO)²⁴, the edges of the axes from Apa²⁵, Covasna (Covasna County/RO)²⁶, Roșiori²⁷ and Săpânța (Maramureș County/RO)²⁸ are quite deteriorated and bear visible use-wear marks. In this latter hoard the pendants and arm-spirals are also deteriorated²⁹, but it is hard to estimate based on the literature alone, whether this is the result of a premeditated interfering (**fig. 2**). At Cernat–Hegyes IV (Covasna County/RO) a Pădureni type axe was discovered with the upper part of the shaft hole broken and attached to the blade. The breakage line on the blade fragment is more worn-out than the one on the shaft hole, suggesting that the object was used for a period of time even after the deterioration³⁰. In both cases the active part of the objects is affected, mainly with partially broken cutting blades, pointing towards an everyday deterioration. In these examples, deliberate interfering

¹⁵ David 2002; 2008; Vachta 2008, 76–85; David 2010; 2013.

¹⁶ Popescu/Rusu 1966, R12,7–8.

¹⁷ David 2002, pl. 129, 5.

¹⁸ Soroceanu 2012, 107–109 pl. 36, 10–12.

¹⁹ Soroceanu 1982, 366 pl. 1.

²⁰ For the Upper Tisza region's fragmentation patterns, see Vachta 2008, 80 fig. 57.

²¹ Soroceanu 2012, pls 1, 1a. 1d–e; 2, 1a–b. 1e.

²² Bader 1991, pl. 6, 27. The four different fragments of one single dagger from the same hoard, which could have pointed towards a deliberate

fragmentation, resulted after a modern intervention. See Soroceanu 2012, 56–57.

²³ David 2002, pl. 123, 4.

²⁴ Soroceanu 2012, pl. 44, 9a. 9c.

²⁵ Popescu 1937–1940, pl. III.

²⁶ Soroceanu 2012, pl. 10, 6.

²⁷ Popescu/Rusu 1966, R12,1.

²⁸ Popescu/Rusu 1966, R8a,1.

²⁹ Popescu/Rusu 1966, R8b,6–8.

³⁰ Puskás 2018, 241; 2019.

cannot be taken into consideration. Several objects from Sânnicolau Român I (Bihor County/RO)³¹, Satu Mare (Satu Mare County/RO)³², Șimleul Silvaniei II (Sălaj County/RO)³³, and Vârșand III (Arad County/RO)³⁴ are missing one or more counterparts but it is difficult to estimate whether they were intentionally altered and deliberately selected for deposition.

Beginning with the last stage of the Middle Bronze Age, the composition of metal deposits around the Carpathian Basin changes, as they become diversified, enlisting a considerable number of tools, weapons, ornaments, and even artefacts related to metalworking activities. The type of hoards, such as Dunaújváros–Kosziderpadlás II (Fejér County/HU)³⁵, Bühl (Lkr. Donau-Ries, Bayern/DE)³⁶, Sittling (Lkr. Kelheim, Niederbayern/DE)³⁷, Mušov (South Moravian Region/CZ)³⁸, with openness towards damaged items was not present in the eastern part of the Carpathian Basin till this period. The first discovery enlisted above is considered the earliest fragmented hoard with an innovative composition³⁹. Assemblages structured mainly and deliberately around damaged objects were absent in Transylvania until the late stages of the Bronze Age. For the first time, there is a correlation with the insertion of small fragments in socketed objects, which could be explained by the possible intention to set apart a certain group of objects within the rest of the hoard, without any utilitarian motivation⁴⁰. Recently, these fragments have been defined as »memorabilia«, whereby the stages in the object's life are associated with the persons and places in which the transformations occurred⁴¹. The new, Koszider type hoard model spread rapidly into new regions, but the distribution of intact and fragmented hoards from the Carpathian Basin follows a conscious pattern⁴².

During the Urnfield period, a gradual shift can be observed in the distribution of such finds from the Carpathian Basin towards North-western Europe⁴³. It seems that a find discovered in the last few years will change the perspective about the earliest damaged hoards from Transylvania. In 2006 and 2012 more than 140 artefacts were discovered near Noșlac (Alba County/RO), on the left bank of the Mureș river. Chronologically, two groups of objects can be separated: one dated to the Bz B and the other one to the Bz D–Ha A1. The first group might belong to the first hoards, for which a new depositional idea was adapted, with a mixed composition (tools, weapons and ornaments/sickle, axe and bracelet) and deliberate fragmentation⁴⁴. The spread of the damaged hoards in the Eastern Carpathian Basin happened in the upcoming evolution phase, when not only the condition of the objects changed, but the structure of the finds developed in a very particular way.

Beginning with the first stages of the Late Bronze Age (Bz C–Bz D–Ha A, c. 1450–1150 BC), the metal depositions from Transylvania are characterised by a high degree of variety and, by losing their former »personal character«, they seem to become communal offerings made by smaller or larger groups. Thus, different regions acquire specific hoard types thanks to a differentiation in the construction of the hoards. Three main hoarding regions can be distinguished, each with different typological characteristics: central, northern and western Transylvanian hoarding regions, overlapping to a greater or lesser extent the different historical regions of Transylvania. The best known area of the Eastern Carpathian Basin in this regard is the Maramureș and the Upper Tisza region, with the Uriu-Opályi type hoards. Thanks to the efforts of Al. Vulpe⁴⁵, T. Bader⁴⁶, C. Kacsó⁴⁷, L. Marta⁴⁸,

³¹ Popescu/Rusu 1966, R13,3.

³² Kacsó 1997, pls I, 2; V, 1; VI, 9.

³³ Bader 1991, pl. 8, 31.

³⁴ Banner/Bóna 1974, fig. 25.

³⁵ Mozsolics 1967, pls 49–50.

³⁶ Rittershofer 1983.

³⁷ Rind 1986, 54 fig. 26.

³⁸ David 2002, pl. 223.

³⁹ Hansen 2013a, 180; 2013b, 380 fig. 9; 2016, 186, 192.

⁴⁰ For this topic, see Hansen 1996–1998, 12–24 figs 4–12; Dietrich 2014, with earlier literature; Tarbay 2017, 84; Dietrich/Mörtz 2019; Rezi/Gogăltan

2019, 208–209 fig. 17; Tarbay 2019, 278; Hansen 2020, 172; Knight 2020, 11; Dietrich 2021, 801–802; Knight 2022, 153–154; Popescu 2023, 53–54.

⁴¹ Sörman 2024, 268–269.

⁴² Hansen 2005; 2013a, 180; 2013b, 380.

⁴³ Huth 2016, 233.

⁴⁴ Hansen et al. 2015, 45–46 fig. 4; Hansen 2016, 194 fig. 15.

⁴⁵ Nistor/Vulpe 1969; 1970; 1974; Vulpe/Lazăr 1989.

⁴⁶ Bader 1969; 1996; 1999; 2001.

⁴⁷ Kacsó 1970; 1977; 1980; 1979–1981; 1990a; 1990b; 1995b; 1995c; 1999a; 2003; 2006; 2007; 2009a; 2012; 2013; 2015.

⁴⁸ Marta 2005; 2013; 2015; 2020.

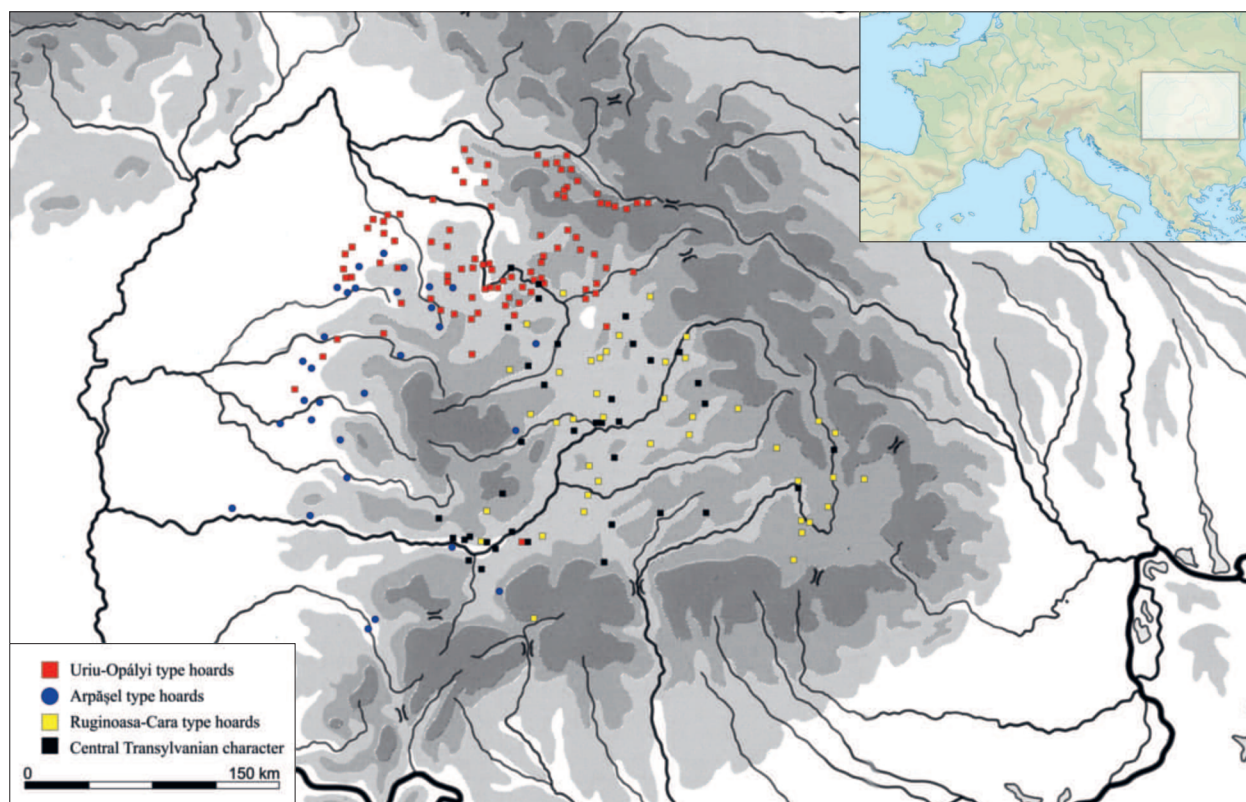


Fig. 3 The geographical distribution of the three main hoard types from the beginning of the Late Bronze Age (Bz D–Ha A) from the Eastern Carpathian Basin. – (Map B. Rezi).

S. Hansen⁴⁹, T. Vachta⁵⁰, among others, older and newer discoveries have been studied and interpreted. In contrast, Western, Central and Eastern Transylvania did not benefit from a detailed analysis of the metal finds. C. Kacsó was the first, who designated the discoveries from Central Transylvania and Moldova with the term Ruginoasa-Cara type hoards⁵¹. Emphasis was placed on the metallurgy of this area only later in terms of specifically structured hoards or fragmentation practices⁵². A separate depositional region was outlined for the Criș river's area (Bihor and Arad Counties/RO), known as the Arpășel type characterised mainly by the deposition of cer-

tain categories of personal ornaments. Various aspects related to the finds of this type were discussed by C. Kacsó⁵³, I. Emödi⁵⁴, N. Chidioșan⁵⁵, S. Dumitrașcu⁵⁶, A. Flontaș⁵⁷, Fl. Gogâltan together with V. Sava⁵⁸ and Fl. Drașovean⁵⁹, and more recently by M. Rotea⁶⁰ (**fig. 3**).

Due to their structure and damaged condition, many of the finds of the Bz D and Ha A period can be classified in the category of scrap hoards⁶¹. The Ha A period is undoubtedly the peak of the Eastern Carpathian Basin metal fragmentation with more than 2/3 of the material being damaged to some degree. Due to the long-term accumulation of metallic

⁴⁹ Hansen 1994, 356–363 figs 206; 208, 9.

⁵⁰ Vachta 2008.

⁵¹ Kacsó 1990b, 246.

⁵² Rezi 2009; 2011; 2016; Soroceanu et al. 2017; Rezi/Gogâltan 2019.

⁵³ Kacsó 1990a, 246; 1995a; 1999b; 2009b.

⁵⁴ Emödi 1978; 1980; 1984; 1992; 1995; 1997.

⁵⁵ Chidioșan/Emödi 1981; 1982; 1983.

⁵⁶ Dumitrașcu 1980; Dumitrașcu/Crișan 1989.

⁵⁷ Flontaș 2014.

⁵⁸ Gogâltan/Sava 2014.

⁵⁹ Gogâltan/Drașovean 2015.

⁶⁰ Rotea 2017.

⁶¹ For the definition of scrap hoard, see Dietrich 2014, 469–471; Huth 2024, 21.

implements, the exact and narrow chronological position of many assemblages cannot be determined. The assemblages from the Maramureş and Upper Tisza regions on the one hand, and the ones from Transylvanian on the other, differ mostly in their typological structure. The first ones can be ascribed to the following categories: 1) hoards consisting entirely of, or dominated by disc-butted axes, 2) hoards consisting entirely of, or dominated by bracelets, and 3) large and small mixed hoards. The association between weapons, personal ornaments, and tools, with emphasis on the first two, seems to constitute a depositional norm for this region. The hoards from Transylvania are characterised mainly by the presence of both sickles and socketed axes, sometimes gathered in clean hoards as well⁶², the bracelets, spearheads and simple chisels, represent secondary components appearing in a rather random fashion (fig. 3).

Since the different aspects of the Central Transylvanian fragmentation patterns have been highlighted for the Bz D–Ha A time span in a previous study⁶³, and since newer and more elaborate divisions have been made⁶⁴, we do not wish to resume a detailed report here. However, a few general remarks will be highlighted in order to outline the very specific practice of voluntary manipulation. Undoubtedly the pinpoint of the Transylvanian fragmentation practice is represented by the 13th–11th centuries BC. The fragmentation patterns throughout this longer time span follow the same principles within the Upper Tisza region and the Transylvanian hoard models. During the Bz D period the northern and the central Transylvanian hoards differ mostly in their typological structure: the former are dominated mostly by weapons (disc-butted axes, spears) and bracelets,

while the later ones consist almost entirely of tools, with only a few weapons and bracelets. The dominant types are mostly intact and the employment of fragmentation targets mostly these objects. Intentional manipulation can be expressed most clearly by fragments with multiple breakage lines, and by different bending techniques, which reshaped the initial form of the object, without necessarily having practical or metallurgical purposes. It is quite possible that regular but intensive use could have produced such bits of artefacts. Similar interventions can be identified on almost every object type, suggesting a calculated action. Still, the possibility of breakage caused by chipping (small bits missing from the rim or blade) reflects a pre-depositional deterioration and cannot be related to the act of deposition itself.

In the Bz D period, there are mostly parts from the upper or rim area of the socketed axes, a few blade fragments and very rarely fragments from the same object. The half or the quarter fragmentation of the rim⁶⁵ is present as well, mainly with the broken bits missing⁶⁶. In the Ha A period the same kind of fragmentation habit is carried on, but in some cases the intensity of this destructive action is more obvious. Fragments from the blades of the socketed axes become more frequent, being recovered in either smaller or bigger parts. Irregular, unnatural breakage surfaces are also present, which were undoubtedly planned and carried out with special tools (fig. 4, A11). Objects broken repeatedly in the same place, especially for no practical reason, or the multi-piece breaks (two or more breakages) could be the result of intentionality⁶⁷. It is often the case that the simple deterioration of the metal does not leave any permanent marks, such as hammering or blow marks (carried out with sharp-edged chisels

⁶² Regarding the clean sickle hoards from Transylvania and Moldova, see Rezi 2009; see also Bejinariu 2018, 37–43; for a general overview, see Fejér 2020, 124–126 fig. 4, 24; 2024, 3–9.

⁶³ For a comprehensive analysis of the fragmentation process from Central Transylvania, see Rezi 2011, 307–319.

⁶⁴ For a general damage ranking system throughout the Bronze Age, see Knight 2020, tabs 1–3; 2022, 26–44 tab. 2.7; for the Transdanubian Late Bronze Age (Ha B1) hoards, see Tarbay 2022c, 139–145 fig. 6, 6–7.

⁶⁵ Wanzek 1989, 230–231; Ciugudean et al. 2006a, 46; 2008, 39–41; 2010, 39–44.

⁶⁶ A few years ago during an experimental investigation two authentic (!) Late Bronze Age socketed axes were used for wood-cutting. One of the objects suffered a major crack, perpendicular with the rim, due to a short handle, whose shaft rested on the rim. Unfortunately, no observations were published regarding the usage marks on the blade and cutting edge of the socketed axe, although a total of 448 blows were applied on woods with different hardness. See Vasiliev et al. 2014, pl. I, 3b.

⁶⁷ Knight 2020, 8–10.



Fig. 4 Distinctive manipulation marks on selected artefacts from the Bz D–Ha A period. – **A:** 1–3 Uriu. – 4 Panticeu. – 5–6 Bătarci. – 7, 14 Suseni. – 8, 11 Bogata de Mureș. – 9–10, 15, 17 Călugăreni. – 12–13 Vâlcele II. – 16 Popești. – **B:** 1, 3 Bancu. – 2 Jabenița. – 4 Perișor. – 5 Mociu. – 6 Bandul de Câmpie. – 7 Bogata de Mureș. – 8–9, 11–12, 14, 16–17 Vâlcele II. – 10, 15 Bogata de Mureș. – 13 Călugăreni. – **C:** 1, 4–5 Crăciunești. – 2, 7 Rebrîșoara II. – 3 Agrieș. – 5 Bătarci. – 8–10 Lăschia. – 11–12, 14 Călugăreni. – 13 Dipșa. – **D:** 1 Uriu. – 2 Mociu. – 3, 5–6 Bandul de Câmpie. – 4 Panticeu. – 7–8, 14–15 Bogdan Vodă. – 9–12 Dipșa. – 13 Vâlcele II. – **E:** 1 Aurel Vlaicu. – 2 Oradea IV. – 3–4 Domănești I. – 5–7, 10–12 Dipșa. – 8 Călugăreni. – 9, 13 Suseni. – (A1–4, 7–15, 17; B1–7; C2–3, 7, 11–12, 14; D1–6, 13; E8–9, 13 photos B. Rezi; A5–6, C6 after Macrea/Kacsó 1972, figs 22, 6, 8; 20, 3; A16 after Kacsó 1995b, fig. 1, 3; C1, 4–5 after Kacsó 2015, figs 90, 2; 92, 3–4; C8–10 after Kacsó 1995c, fig. 5, 1, 4–5; C13, D9–12, E5–7, 10–12 after Ciugudean et al. 2006a, pls 28, 6; 29, 1–3, 5, 8–9; 30, 1, 3–5; D7–8, 14–15 after Motzoi-Chicideanu/Iuga 1995, fig. 1, 41–44; E1 after Berciu/Popa 1967, fig. 3, 1; E2–4 after Bader 1991, pls 16, 133; 20, 186–187). – Not to scale.

and axes, blunt objects like hammers), bending or folding. This can be explained by the process known as »hot-shortening«, which implies that when heated and struck, the copper alloy breaks easily, resulting in a sharp fracture surface⁶⁸. A great example of the intentional manipulation is the socketed axe from Călugăreni (Mureş County/RO): after removing the wooden handle, a direct blow was applied to the rim; a crack appeared on the other side as well; before or after this manipulation, the blade, which was never selected for deposition, was also broken (**fig. 4, A9**). From the category of the completely destroyed socketed axes, the fragments mostly from the rim area (half or quarter fragmentations) are common, but in contrast to the previous period, they were frequently selected within the Ha A hoards (**fig. 4, A12. 15–16**).

The sickles of the Bz D–Ha A period suffered different levels of fragmentation on different parts of the artefact. Thus, no general rule can be outlined, because each part of the object, namely the tip, the blade and the handle area is affected. The broken but complete artefacts are scarce in both periods. In Bz D, bending was rarely employed, possibly due to the hot-shortening technique, but in the next evolution phase it became a common practice. Usually it affected the middle of the blade or the fragment was bent in half (**fig. 4, B**). Analysis of sickles from the Uioara de Sus hoard (Alba County/RO), the largest Late Bronze Age hoard from Europe, revealed that deliberately manipulated, broken and bent sickle fragments were hoarded by choice, many of them with several fitting counterparts⁶⁹.

The most common weapon types of the mentioned periods are the battle-axes, mostly in the northern regions, and the spearheads in the northern and central regions. The fragmentation of the former focuses mainly on the shaft area, but the disc and spin, and sometimes the blade can be also affected. In Ha A, the few fragments present the same kind of destruction patterns with a slight accent on bend-

ing (**fig. 4, C**). The spearheads have very few obvious fragmentations in the Bz D period. These are the result mostly of a regular use which involved mainly the active part and can be considered unintentional prehistoric damage. It seems that the deposition of spearheads didn't require exaggerated manipulation and a few breakages implemented most probably with the hot-shortening technique, or other use-wear chippings were enough for carrying out the act of hoarding. In some cases, one can find almost identical damage marks (**fig. 4, D1–2**). Over time, spearheads became more fragmented. Fragments of different sizes from the tip, the blade, occasionally from the socket area became frequent (**fig. 4, D7–15**). Multiple breakage lines became more prevalent as well. The usual usage marks are also present, suggesting a normal utilitarian function prior to fragmentation and hoarding.

From the Ha A period, the swords are the second most widespread weapon type, after the spearheads. There is hardly a sword in Ha A which is not fragmented in some way or to some degree⁷⁰. Usually, the most common parts affected are the blade and the handle, the tip fragments representing scarce appearances. The intentional manipulation is stressed by the recurrent bending, which affects almost every part of the artefact. The chopping up of the blade is common among swords, resulting in multiple breakage surfaces, seemingly without any visible marks or employed tools, thus a rational, mundane motivation seems unlikely. The counterparts to the fragments are usually missing (**fig. 4, E**). The purposeful executed deterioration is illustrated convincingly by two fragments from Suseni (Mureş County/RO): if we fit one handle and one blade fragment, the entire process of bending can be seen, which was continued even after the sword broke at the first rivet hole; the aim was in fact the total bending of the piece; most probably the rest of the blade was also broken before this moment (**fig. 4, E9–9a**).

⁶⁸ Knight 2019, 252–253 figs 14–15; 2022, 16–17; Huth 2024, 22.

⁶⁹ Information kindly offered by Fl. Gogâltan, whom I would like to thank on this occasion.

⁷⁰ The dating of the few intact swords covers a wider chronological time span, reaching back until the Bz D period. No type can be narrowed down

exclusively to the Ha A time span. The late Ha A, or the so-called Ha A2 types, are typologically closely linked to the Ha B1 period. See Bader 1991, 71–149.

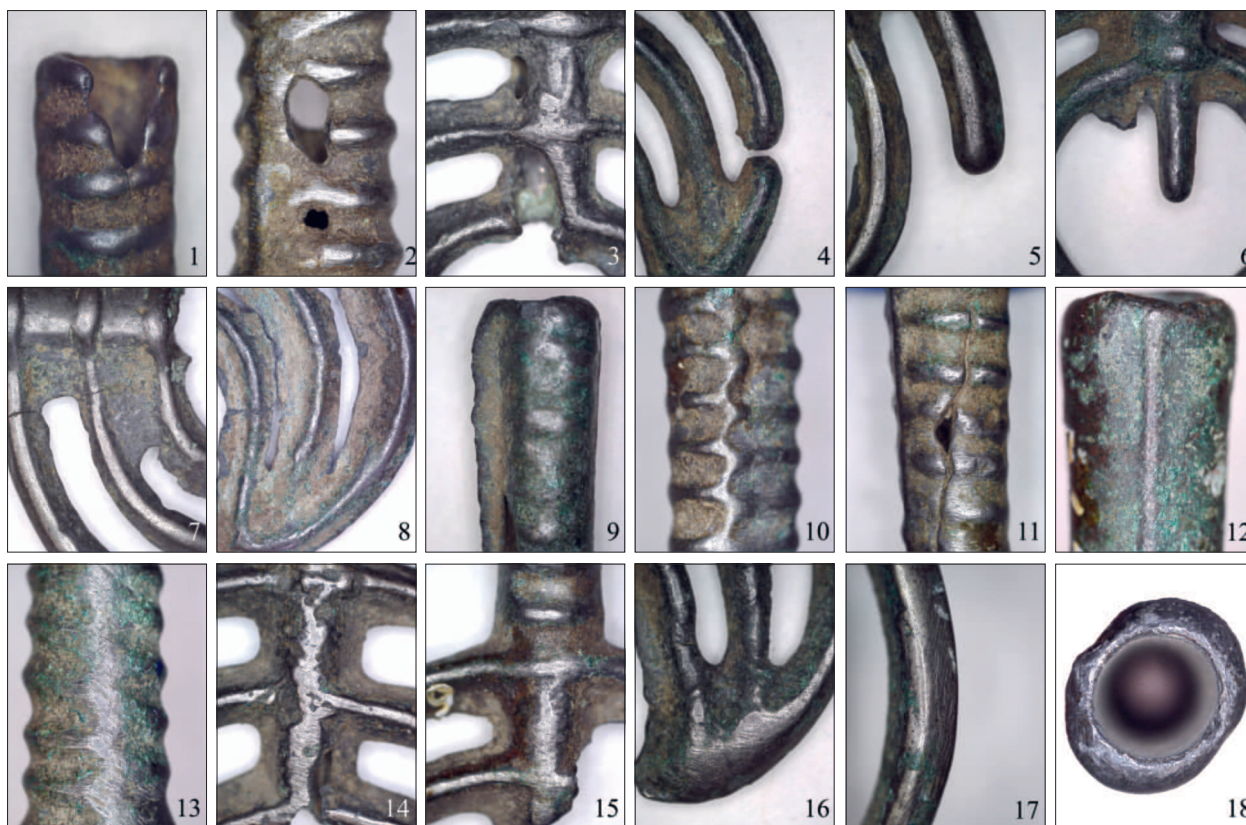


Fig. 5 Manufacture traces and casting defects on crescent-shaped pendants with vertically perforated and ribbed shank from Giulia. – 1–5 Incomplete cast on the crescent and shank. – 6 Misrun defect between the crescent. – 7–8 Metallic projection. – 9–10 Mismatch defect on the shank. – 11 Crack along the shank. – 12 Flash defect on the shank. – 13–17 Abrasion on the shank, between and on the tip of the crescent. – 18 Worn-out rim of the shank. – (Photos B. Rezi).

The intentional manipulation is explicit, when analysing the saws. Three methods of fragmentation can be distinguished: a) bending into two, b) bending into more than two parts and c) the coiled pieces. Such objects usually ended up in the large, so-called founders' hoards from Transylvania.

The Western Romanian hoards, from the Criş river's region (see **fig. 3**), have to be evaluated from another perspective, due to their very specific and different structure compared to the other neighbouring regions. They consist exclusively or in a very high proportion of ornaments, namely pendants, *phaleræ*, *tutuli*, buttons, *saltaleoni*, chain hangers, rarely bracelets, pins, arm-guards and even belts. Weapons such as disc-butted axes, spearheads, swords, daggers and tools like sickles, socketed axes, knives, even

raw materials are almost entirely absent from their composition⁷¹. The damage marks are not unknown, but the intentional manipulation and voluntary destruction in the case of such artefacts is challenging to prove and hard to separate from normal use-wear marks or even from casting defects. The deterioration seems to be the result of normal, but extended or demanding usage. Generally, the rim area of *tutuli*, *phaleræ* and buttons is damaged or cracked, the loop of the pendants is broken. Small bits from pendants with vertically perforated shanks are also present. This type of casual deterioration is well illustrated by several Middle Bronze Age Tolnanémedi type⁷², as well as by the slightly later Koszider assemblages⁷³, all dominated by jewellery and clothing accessories. They enlist comparable broken items,

⁷¹ Mozsolics 1973, 69; Kacsó 1990a, 246; 1995a; Hansen 1994, 356 figs 208, 10; 209, 10; Flontaş 2014; Rotea 2017, 43–57; Flontaş 2018.

⁷² Pusztasárákánytó (Somogy County/RO) (Jankovits 2021, figs 3, 3. 6. 11. 15; 4, 6. 16; 6, 4), Tata-Nagy Sándor utca (Komárom-Esztergom County/RO) (Cseh 1997, 4–5 tábla), Zalasabbar (Zala County/RO) (Honti/Kiss 2013, figs 3, 9–11. 18–22. 24; 4, 2; 5, 12–13).

⁷³ Jószerdózsza-Kápolna halom III (Jász-Nagykun-Szolnok County/RO) (Găvan 2024, pl. 9, 2–4), Košice-Barca I (Košice Region/SK) (Găvan 2024, pl. 10, 9–10), Spišský Štrvok III (Prešov Region/SK) (Găvan 2024, pl. 16, 2), Spišský Štrvok VIII (Găvan 2024, pl. 18, 3), Spišský Štrvok IX (Găvan 2024, pl. 19, 1), Spišský Štrvok XI (Găvan 2024, pl. 20, 15. 18. 20).

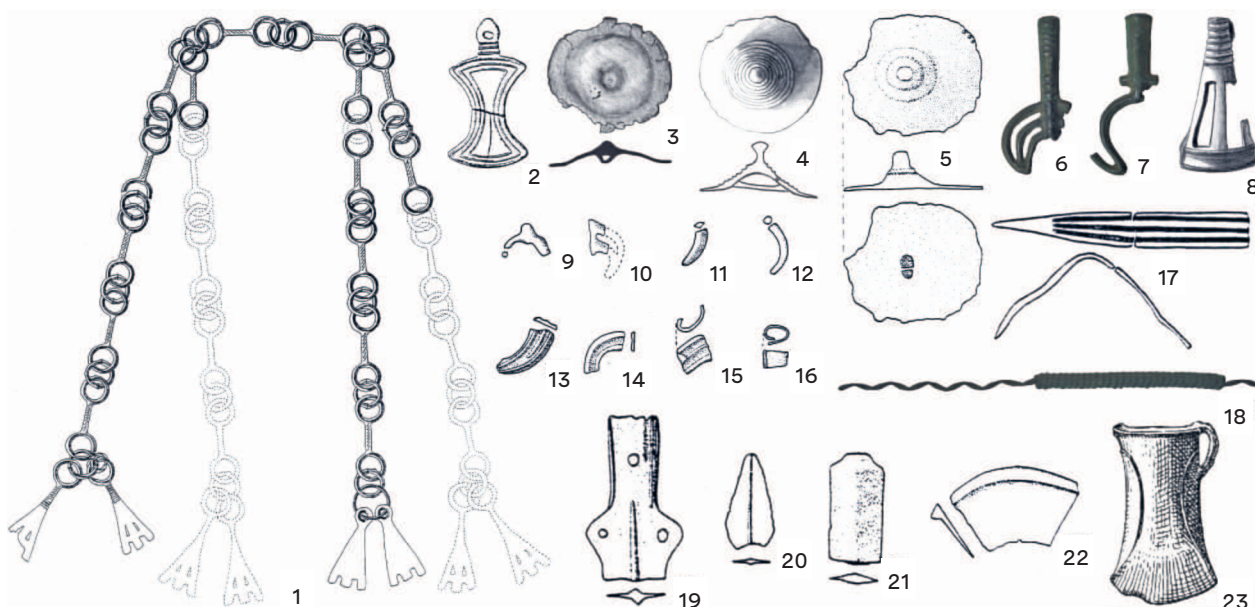


Fig. 6 Deterioration marks on selected objects from the Arpășel type hoards. – 1–2 Arpășel. – 3 Lipova. – 4, 8, 17, 19–23 Oradea IV. – 5, 9–16 Minișu de Sus. – 6–7, 18 Giula. – (1–2, 5, 9–17, 19–22 after Kacsó 1995a, figs 2; 3, 9; 9, 13, 20–23, 25–28; 5, 18; 3, 26–28; 5, 19; 3 after Gogâltan/Sava 2014, fig. 1, 5; 4, 8 after Gogâltan/Drașovean 2015, pls 7, 1; 9, 1; 6–7, 18 photos B. Rezi; 23 after Roska 1942, fig. 219, 29). – Not to scale.

with missing bits and fragments of varying sizes. As fragmentation is not a general characteristic of these finds, similar damage may imply everyday use. In some cases, the reconstruction of the complete set of accessories of a person is also challenging.

A closer look at the manufacture traces and use-wear marks on dozens of crescent-shaped pendants with perforated shank from the Giula hoard (Cluj County/RO) reveals that the metalworker had great difficulties in casting a proper item. The majority have incomplete castings and misrun defects, mismatch shanks and the number of ribbings on the two sides often do not match. Almost every pendant is a semi-finished product, as no post-casting treatment is observable (such as removed casting seams, grinding, polishing or hammering). The overflow of the metal on the tip of the crescents proves that even this part was left untreated after casting. It seems that the pendants were used the way they were cast – almost as as-cast items. Still, heavy and/or light use-wear abrasion is present on the most exposed surfaces, such as the ribs and casting seams on the shank, just like the tips of the crescent (**fig. 5**). The same is true for the *saltaleoni* fragments, since every

item was hoarded in as-cast state. The main goal was the »mass-production« of these pendants to achieve a desired quantity for the final accessory/accessories, disregarding the quality of the final product⁷⁴. Bending, as a specific practice of the period, is rarely used in the Giula or any other hoard of the time. Without proper and holistic surface and use-wear analysis similar to the one carried out on the items from Giula, plausible conclusions regarding the factual usage of the Arpășel type assemblages cannot be drawn (**fig. 6**).

Based on the high number of ornaments, it was recurrently argued that similar finds could have represented the clothing accessories of women⁷⁵ or even men within certain ritual practices⁷⁶. A similar assumption was outlined for the hourglass pendants and *saltaleoni*, which were either hung on organic strand, forming a necklace, or were attached to arm-spirals, pendants and even fibulas⁷⁷. The same was put forward for the pendants with vertically perforated shanks⁷⁸. The thousands of *tutuli* from the hoards of Cioclovina (Hunedoara County/RO), Cehăluț I (Satu Mare County/RO) and Otomani (Satu Mare County/RO) have been defined in the context of

⁷⁴ Kavur et al. forthcoming.

⁷⁵ Boroffka/Luca 1995, 226; Jankovits 2010, 52; Király et al. 2014, 316–322.

⁷⁶ Schumacher-Matthäus 1985, 81–84, 99, 101, 105; Jankovits 2006, 64–65; Gogâltan/Sava 2014, 200–201; Ilon 2015, 145–150.

⁷⁷ Mozsolics 1985, 61; Kacsó 1995a, 99; Jankovits 2016, 164.

⁷⁸ Kacsó 1995a, 101; Jankovits 2015, 243–247 fig. 5, 1–2; Jankovits et al. 2015, 877 fig. 3; Jankovits 2017, 213–215.

a hoard model based on woman-horse accessories⁷⁹. A special kind of selective practice is supported by the fact that in certain hoards from the Criş river's area, in which the horse bits or other harness objects appear, the *tutuli*, buttons, and *phalerae* are missing⁸⁰. Furthermore, it has been pointed out that elements from chain-pendants (Arpăşel and Guruslău type) are never associated with horse equipment⁸¹, and no such artefact has been discovered within a horse burial⁸². Due to the very low number of graves with metal offerings, a comparison with grave goods is not elucidative⁸³. Several graves contain only a few ornaments, generally one or two items⁸⁴. Some parts from complex chain-pendants were recovered from a north-eastern Hungarian cremation grave without any hint concerning their actual function⁸⁵. Ornaments are by far the most common objects found within settlements, most of them deteriorated through use and wear⁸⁶. The intensive accumulation within hoards has no parallels in the grave finds or the isolated finds from settlements⁸⁷. Therefore, the actual function and the real social dimensions of these artefacts is difficult to comprehend from the perspective of the hoards. Each find has a unique composition, with alternating ornament types and changing numbers. Such assemblages convincingly confirm the purposefully orchestrated practice of selective deposition and conscious exclusion from certain social spheres.

By their very nature, ornaments have a strong personal association. Fragmentation, in the case of similar hoards, mostly with composite artefacts, can be represented also by the absence of one or more

elements, which are an essential part of the ornament⁸⁸, and which may reflect the cessation of individual identities⁸⁹. Repair of several items was highlighted in the case of the Arpăşel type pendants⁹⁰, so it is not uncommon for such artefacts to break. A large amount of ornaments with missing attached parts can be defined as remains of a natural deterioration, which never got repaired. This, however, does not entirely explain the diverse structure and the long accumulation period of the finds. The decisive alteration of their function can be best expressed by the missing components, which were detached from the multi-part ornament. Based on this theory, the objects do not necessarily have to bear evident damage marks, because the simple absence of some parts, as well as the lack of the necessary organic component (leather, fabric)⁹¹, can illustrate a deliberate manipulation.

Beginning with the Ha A2/B1 period (c. 1150–950 BC), together with the spread of the Gáva type ceramic, we witness a significant decrease in the number of the hoards and the artefacts within them, along with a change in the structure of the assemblages⁹². During this stage, the broken items become less and less significant. Two major groups of finds can be separated in this period: beside the increasing number of lavish finds with representative items such as swords, metal vessel sets and defensive items such as helmets, the common hoards are dominated by socketed axes, sickles, bracelets, along with spearheads and a high percentage of raw material⁹³. Many of the common hoards comprise a large number of chronologically diverse, often damaged or

⁷⁹ Metzner-Nebelsick/Nebelsick 1999, 82–98 fig. 5; Metzner-Nebelsick 2005, 328–331 fig. 6.

⁸⁰ Gogâltan/Sava 2014, 193.

⁸¹ Kacsó 1995a, 97.

⁸² Jankovits 2010, 52.

⁸³ Concerning several grave finds from this region, see Motzoi-Chicideanu 2011, 656–659.

⁸⁴ In this regard, see Sava/Andreica 2013, 54–58 figs 5–6; Gogâltan/Sava 2014, 193–194, with a short list of graves and with older literature.

⁸⁵ Jankovits 2010, 51; 2017, 254–258.

⁸⁶ Gogâltan et al. 2013, 48, with previous literature and a short list of settlements from the region. See also Szabó 2009, 20, for eastern Hungary.

⁸⁷ Vlahu-Pad (Cluj County/RO) (Gogâltan et al. 2011, 164–167); Petea-Csengersima (Satu Mare County/RO) (Marta 2009, 44–45); Nyíregyháza-Oros-Úr Csere (Szabolcs-Szatmár-Bereg County/HU) (Bejinariu 2010,

47–53); Şagu-Site A1_1 (Arad County/RO) (Sava et al. 2012, pl. 4, 2–4); Sântana-Cetatea Veche (Arad County/RO) (Gogâltan et al. 2013, pls 1, 1.3; 5, 1–3. 6. 9–12; 6, 1–2. 5; 9, 3).

⁸⁸ Hansen 1996–1998, 8–19; Tarbay 2017, 90.

⁸⁹ Fontijn 2002, 239; Knight 2024, 248–250.

⁹⁰ Kacsó 1995a, 95 fig. 2.

⁹¹ Schumacher-Matthäus 1985, 99.

⁹² Kemenczei 1996, 78–84; Vachta 2008, 106–112. For a revised chronological classification of the Gyermely type discoveries and the Ha A2/B1 period, see Tarbay 2015a. For a general overview on the Ha B1 hoarding practices from the eastern half of the Carpathian Basin, see Szabó 2017a; Tarbay 2022a; 2022b, 66–72.

⁹³ Marta 2015, 274. 279–280; Szabó 2017a, 254–255; Tarbay 2022b, 69–70.

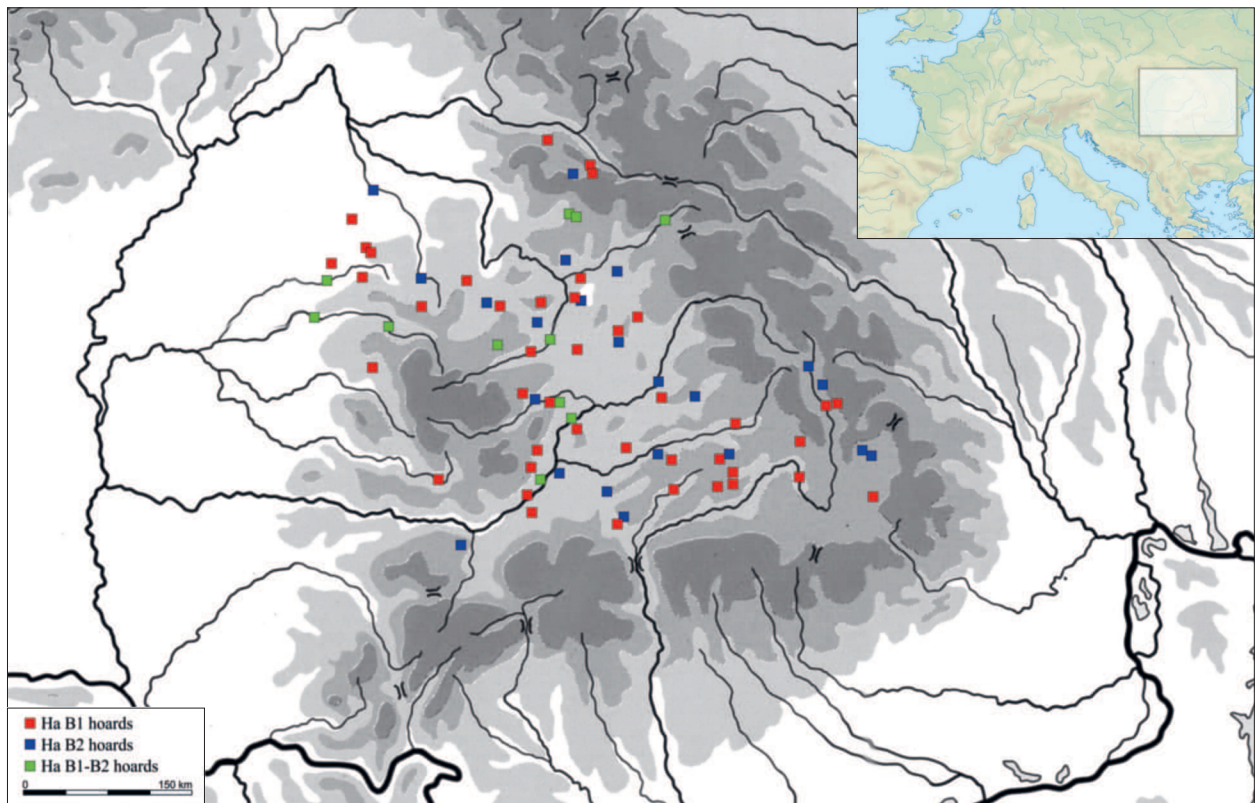


Fig. 7 The geographical distribution of the hoards from the evolved stages of the Late Bronze Age (Ha B1–Ha B2) from the Eastern Carpathian Basin. – (List of hoards after Ciugudean et al. 2008, figs 47–52; Marta 2015, tab. 1; map B. Rezi).

fragmented artefacts, while some of the objects are foreign to the region they were deposited in⁹⁴. The clean socketed axe and clean sword hoards are basic features of the period⁹⁵. The fragmentation habit is similar in other parts of the Carpathian Basin as well. In Transdanubia, hoards present a similar fragmentation pattern, and can be divided into four groups: the workshop hoards with heavily fragmented ingots and by-products, hoards with broken and those with intact objects, and finally assemblages with partitioned and intact ingots with fragmented objects. A series of eight different manipulations have been identified within these finds⁹⁶, all of which are present in the studied region as well.

The geographical distribution of the hoards within the eastern edge of the Carpathian Basin shifts towards southeast and they are almost totally absent in the western regions of Romania, namely in Crișana and Banat (fig. 7)⁹⁷. The degree of damage is much lower than in the first two periods of the Late Bronze Age (Bz D–Ha A). Despite the presence of destruction, the leading types, namely the socketed axes, sickles, swords, spearheads, and metal vessels are predominantly intact, without too many obvious or intentional damage marks. The counterparts of the broken objects are generally selected for deposition, thus the number of sliced but complete items is significantly higher than in previous evolution phases⁹⁸.

⁹⁴ Dietrich et al. 2022, 13–17.

⁹⁵ Soroceanu/Lakó 1995, 190–192 fig. 3; Metzner-Nebelsick 2002, 73 fig. 16; Vachta 2008, 48–64 fig. 30; Soroceanu 2011a, 244–248 fig. 10; Tarbay 2019, 298–304; Dietrich 2021, 792–798; 2023.

⁹⁶ Tarbay 2022c, 139–140.

⁹⁷ Soroceanu 1982, 367–368 fig. 5; see also Marta 2017, 200–201.

⁹⁸ Szabó 2011, pls 8, 2–3; 9, 3–5; 2017a, 255; Marta 2017, 204–205; Szabó 2019, figs 85–86. 97–98. For the western regions of the Carpathian Basin, namely Transdanubia, see Tarbay 2022c, 139–145.



Fig. 8 Distinctive manipulation marks on selected artefacts from the Ha B1-B2 period. – 1 Oradea. – 2 Turia I. – 3 Jucu de Mijloc. – 4 Șoarș. – 5 Sărvăzel. – 6 Dezmir. – 7 Tăuteu. – 8 Pir. – 9–11 Dezmir. – 12 Predeal II. – 13–14 Diosig. – 15 Călinești. – 16 »Transylvania«. – 17 Bunești. – 18 Gura Arieșului. – 19 Sărvăzel. – (1 after Ciugudean/Ciută 2008, fig. 2, 2; 2. 6. 9–11 photos B. Rezi; 3 after Kacsó 1994, fig. 2, 2; 4 after Ciugudean et al. 2008, pl. 9, 1; 5. 19 after Iercoșan/Németi 1991, pl. 1, 1. 4; 7 after Petrescu-Dîmbovița 1961, fig. 5, 1; 8 after Marta 2015, pl. 5, 3; 12–18 after Bader 1991, pls 36, 329; 38, 341; 48, 356. 359; 50, 361; 52, 366. 369). – Not to scale.

The majority of the socketed axes from Transylvania are intact, at best they display everyday usage marks, focused mostly on the blade and cutting edge⁹⁹. Even when the artefacts are damaged, notches, breakages and deformations on the cutting edge point towards an everyday use, furthermore the intensity of damage shows that most of them could still have been used¹⁰⁰. Several examples point towards a deliberate fragmentation, mainly hacking into pieces. In the hoards from Pir (Satu Mare County/RO)¹⁰¹, Șoarș (Brașov County/RO)¹⁰², Suatu (Cluj County/RO)¹⁰³, Tăuteu (Bihor County/RO)¹⁰⁴, one can find axes cut in half, sometimes with recognisable punch marks along the breakage surfaces. These relics may point to the already mentioned hot-short-

ing technique. The multiple breakage line on the cutting edge of a socketed axe from Sărvăzel (Satu Mare County/RO)¹⁰⁵, Josani (Bihor County/RO)¹⁰⁶, or the lower or upper parts of axes from Sărvăzel¹⁰⁷, Arad II (Arad County/RO)¹⁰⁸, Moigrad I (Sălaj County/RO)¹⁰⁹, Săcuieni (Bihor County/RO)¹¹⁰, Suatu¹¹¹, Șpălnaca I (Alba County/RO)¹¹², Vărd (Sibiu County/RO)¹¹³, most surely can be listed as deliberate fragmentation practices (fig. 8, 5–7).

The various matching bits of the sickles testify most clearly the intentional manipulation of the bronze items. Slicing the blade of the artefact into two or three distinct bits with several preceding and preliminary breakage lines, like in the hoards from Pir¹¹⁴, Zagon I (Covasna County/RO)¹¹⁵ and Vărd¹¹⁶,

⁹⁹ Regarding the voluntary execution of such marks, see Ciugudean/Ciută 2008, 353; Marta 2015, 272; see also Tarbay 2022b, 64–66; 2022d, 50–52; 2024, 188–192.

¹⁰⁰ Dietrich et al. 2022, 10.

¹⁰¹ Marta 2015, pl. 3, 6.

¹⁰² Ciugudean et al. 2008, pl. IX, 1.

¹⁰³ Petrescu-Dîmbovița 1977, pl. 322, 9.

¹⁰⁴ Dumitrescu 1935/1936, fig. 2.

¹⁰⁵ Marta 2017, fig. 5, 1.

¹⁰⁶ Petrescu-Dîmbovița 1977, pl. 309, 8.

¹⁰⁷ Marta 2017, fig. 5, 3.

¹⁰⁸ Petrescu-Dîmbovița 1977, pl. 296, 11–12.

¹⁰⁹ Petrescu-Dîmbovița 1977, pl. 310, 10–11.

¹¹⁰ Petrescu-Dîmbovița 1977, pl. 315, 5.

¹¹¹ Petrescu-Dîmbovița 1977, pl. 322, 21–24.

¹¹² Petrescu-Dîmbovița 1977, pl. 325, 11. 16.

¹¹³ Ciugudean et al. 2010, pl. XI, 1–4.

¹¹⁴ Marta 2015, 273 pl. 5, 1–3. See also a detailed description of the fragmentation patterns.

¹¹⁵ Petrescu-Dîmbovița 1978, pl. 249, D4.

¹¹⁶ Ciugudean et al. 2010, pl. X, 1. 3.

demonstrates a clear and wilful action. If they were to be remelted or discarded from practical use, the fitting counterparts would have not ended up in the final deposition. Bending, as a widespread manipulation practice in the previous period, is rarely employed in these finds. Extremely suggestive in this sense are the sickles which were bent into a ring, thus making the artefact unfit for use¹¹⁷. All in all, compared to the countless sickles from earlier periods, these are rarely manipulated (**fig. 8, 8–11**).

Regarding the swords, H. Ciugudean drew attention to two types of damage: firstly, there are minor damage marks on the edges of several swords, as a result of intensive use, and secondly, the repeated fragmentation and slicing of the blade as a distinct custom¹¹⁸. The same idea is supported by the swords from Predeal II (Braşov County/RO)¹¹⁹ and Transylvania¹²⁰ on which the splitting of the blade most probably happened after the tip had suffered damage. The hoard from Diosig (Bihar County/RO) aligns unusually small fragments for this period, one of the broken bits has two breakage surfaces as well¹²¹ (**fig. 8, 12–14, 16**). The selection of spears in multiple fragments, namely parts from the tip, blade

and socket, is a characteristic element of the hoards from the Ha A period, but this practice disappeared with the following centuries¹²². Several deep punch marks can be observed on a few spearheads, which seem too sharp and excessive to be considered regular usage marks¹²³ (**fig. 8, 19**).

After the Ha B1 period, the practice of fragmentation becomes very scarce, only the metal vessels and swords are sometimes found in a much damaged state. A specific custom of fragmentation is shown also through the first category of objects. Although they were recovered in low numbers, there is no single artefact from Transylvania in Ha A which is intact. In the upcoming evolution phases mainly intact vessels were buried, which were clearly left undamaged or just symbolically made unusable. These practices betray two distinct mentalities in two different time periods, most possibly connected to ritual damage rather than metallurgical one¹²⁴. The sword fragments from Călineşti (Maramureş County/RO)¹²⁵, Buneşti (Braşov County/RO)¹²⁶ and Gura Arieşului (Alba County/RO)¹²⁷ present multiple breakage surfaces, suggesting repeated acts of manipulation. The later one is also slightly bent (**fig. 8, 15, 17–18**).

A Threshold Discovery of Hoarding from the Eastern Carpathian Basin

The archaeological research of the bronze hoards of the last decades proposed a model of synchronic evolution, as opposed to the previously held views regarding succeeding chronological horizons. In the majority of the cases, highlighted by the Uriu-Opályi and Arpăşel type hoards, covering the Bz D–Ha A periods¹²⁸, by the

merge and longer evolution of the Ha A2–B1 hoards as well¹²⁹, proves that the dating of certain discoveries covers wider time spans with longer accumulation periods¹³⁰. The structure of the hoards, the condition of the objects, and the trends of the deposition clearly show a deliberate line of conduct¹³¹.

¹¹⁷ Ciugudean 2015, fig. 2; Szabó 2019, 129 figs 105, 110.

¹¹⁸ Ciugudean et al. 2008, 39.

¹¹⁹ Bader 1991, pl. 36, 329.

¹²⁰ Bader 1991, pls 36, 330; 38, 341.

¹²¹ Bader 1991, pl. 48, 356, 359. It is hardly possible that the four fragments can be assigned to two separate swords, based only on their cross-section and patina. See Bader 1991, 151–152.

¹²² Ciugudean et al. 2008, 40; Tarbay 2022b, 67–68.

¹²³ Marta 2015, 273 pl. 4, 3.

¹²⁴ Soroceanu 2005b, 390; 2008, 275.

¹²⁵ Bader 1991, pl. 50, 361.

¹²⁶ Bader 1991, pl. 52, 366.

¹²⁷ Bader 1991, pl. 52, 369.

¹²⁸ Nistor/Vulpe 1974, 15; Kacsó 1979–1981, 377–378; Vulpe/Lazăr 1989, 243; Kemenczei 1991, 43; Kacsó 1995a, 108–109; 1995b, 136; 1995d, 102; Metzner-Nebelsick 2005, 320–328; László 2006, 127–128; Gogăltan/Sava 2014, 195.

¹²⁹ Hansen 1994, 397–405; Turk 1995, 89–99; Hansen 1996, 438; Novotná 2000; König 2004, 1–27; Vácz 2014, 51; Tarbay 2015a, 326–327, 332 figs 15–16; 2015c, 224.

¹³⁰ Hansen 2016, 194–197; Vachta 2016, 110 fig. 9; Soroceanu et al. 2017, 61–68; Szabó 2017b, 131.

¹³¹ Rezi 2016, 412–413 fig. 7.



Fig. 9 The hoard from Bandul de Câmpie (selection). – (Photo B. Rezi).

Looking at the above described fragmentation patterns, it is clear that it evolved across different time periods and geographical regions. Its intensity and execution was constantly changing and certain regions had their distinctive customs in specific time spans. Thus, one can rightfully ask whether it is possible to identify special hoards, which appear as a deviant element in this phenomenon of fragmentation. Such assemblages should represent landmark innovations, pointing towards a new hoarding practice of a specific or upcoming period. It is the case of the first hoards with fragmented objects and specific composition, which appeared in Transdanubia, as was demonstrated in the last years¹³².

In this regard, the hoard from Bandul de Câmpie (Mureș County/RO) is an illustrative example for the Eastern Carpathian Basin (**fig. 9**). It is one of the

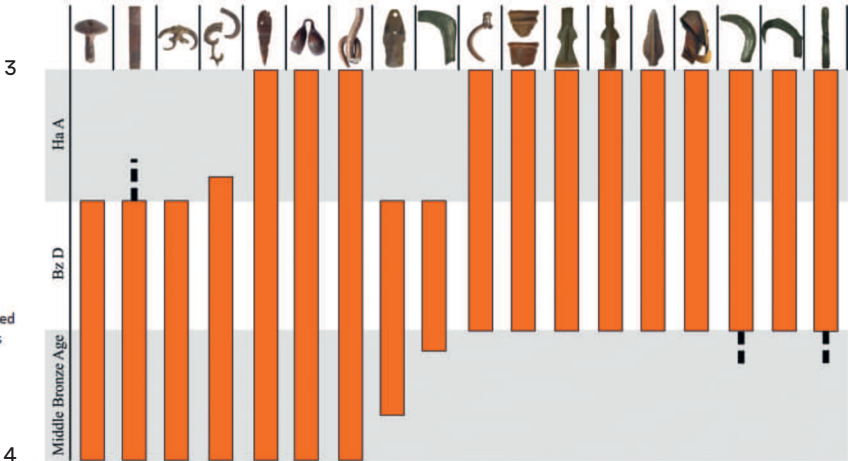
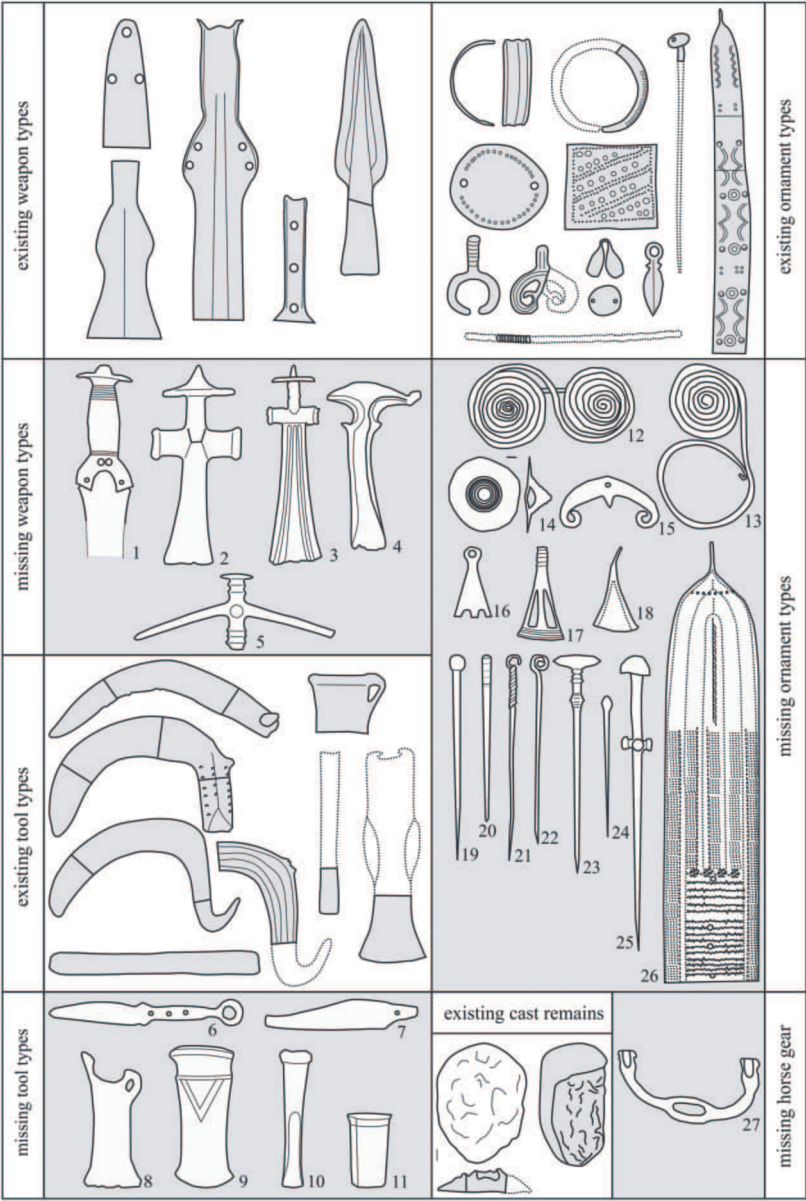
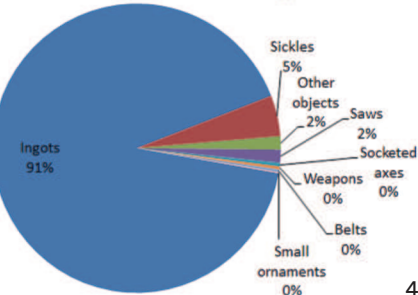
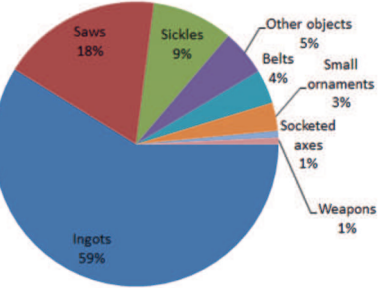
largest bronze hoards of the Urnefield period from the European continent. Looking at the general picture of the hoard, it is clear at first glance that it is a special assemblage, showing several distinctive elements, not seen in other contemporary classified hoards¹³³. Analysing the hoards from Uioara de Sus, Șpălnaca II (Alba County/RO), Aiud (Alba County/RO), Dipșa (Bitrița-Năsăud County/RO), Gușterița II (Sibiu County/RO) and Bicz II (Maramureș County/RO), one will not find proportionally so many scrap pieces and repairs as in the hoard from Bandul de Câmpie¹³⁴. Compared to other large Transylvanian finds, the treasure under discussion has a one-sided structure, with only a few object types playing a dominant role within the find, mostly ingots, saws, and sickles (**figs 9; 10, 3–4**). The deliberate manipulation is present on the majority of types, often im-

¹³² Hansen 1996–1998; 2013a; 2013b; 2016.

¹³³ For a comprehensive analysis of the find, see Soroceanu et al. 2017.

¹³⁴ In this regard, see Rusu 1963; 1981; Petrescu-Dîmbovița 1977; Ciugudean et al. 2006a; Szabó/Rezi 2022, 93–94 fig. 5, 12.

Fig. 10 The specific structure and inner chronology of the Bandul de Câmpie hoard: **1** Missing and existing object types within the hoard. – **2** Chronological span of the main types. – **3** Numerical distribution of the main object types. – **4** Weight of the main types. – (After Soroceanu et al. 2017, figs 16–17. 22. 33).



plemented in an exaggerated manner: the multiple breakage, the bending, folding, twisting, the entirely rolled up items, the heavy blows and crushing of the sockets and blades of tools and weapons were no unfamiliar interventions to the people from Bandul de Câmpie.

The specific artefact types of the Ha A period, such as the battle-axes, socketed axes and chisels, knives, fibulas, the very diverse category of the needles, the wide belts are totally ignored. Other object types, like the swords, spearheads or pendants are represented only by several items, giving its peculiar composition (**fig. 10, 1**). Concerning the general chronological picture of the hoard, it is important to note not only the lack of characteristic Bz D objects but also the lack of artefacts, which can be dated exclusively to the Ha A period: there are no wide decorated belts (like at Uioara de Sus, Gușterița II, Dipșa, etc.), no Bohdalice fibulas, no Friedrichsruhe bronze-cups, no pin types which are specific to the Ha A pe-

riod. In a hoard find of such dimensions and proportions, this is surprising. The existence of certain pieces that can be roughly dated to the Bz D–Ha A time span, does not justify the dating of the hoard to the Ha A, as was mentioned earlier (**fig. 10, 2**).

Taking all this into account, we believe that the burying of the hoard from Bandul de Câmpie was carried out in the Bz D period. Although it prepares the transition to the Ha A period, the hoarding, namely the burying itself, does not pass this threshold¹³⁵. This very early component is not noticeable in any other large hoard from Transylvania. Thus, the hoard from Bandul de Câmpie can be considered as the preparatory one for the upcoming later hoards as being the earliest expression of a large-scale metallurgy from the Transylvanian Basin, and as the largest and the most fragmented find of the period. Still, the general fragmentation pattern of the find anticipates the upcoming Ha A period without any parallels in the Bz D phase.

The »Missing Hoard«

An extremely intriguing question is represented by the missing chunks from the broken objects, or rather by the relationship between individual fragments and pieces belonging to the same object¹³⁶. The majority of the broken artefacts lack their suitable counterparts or the broken bits of the damaged pieces are missing. In contrast with the high number of artefacts, very few hoards contain fragments which can be fitted together. In most cases, the entire artefact can be outlined but there are some exceptions, when a third or fourth part is missing as well. Despite their low number, objects of similar nature show some sort of preference towards the dominant types of certain periods, but still present a certain formal diversity (**fig. 11**). To our knowledge, no broken object from the Romanian Bronze Age has ever been discovered in two separate locations and reas-

sembled. A very revealing example in this respect is a fragment of an Ewart Park type sword discovered in Hanford (Staffordshire/GB) in 1996 and found to conjoin with a sword tip found previously 3 miles away in Trentham Park (Staffordshire/GB). The two distinct hills were separated by a river, marking different spots in the landscape¹³⁷. A similar but slightly different example can be mentioned from a Swedish burial ground where two fragments, seemingly from the same neck ring, were found in two different graves¹³⁸. In addition, two refitting fragments of a stone moulds for a socketed axe deposited in adjacent houses from Gwithian (Cornwall/GB) may point towards an enchainment relationship between two households¹³⁹.

Starting from this idea one can reflect on the broken parts, the missing or skipped fragments from

¹³⁵ Soroceanu et al. 2017, 63–68 fig. 34.

¹³⁶ Hansen 1994, 360; Vilaça/Bottaini 2019, 133–136; Knight 2022, 98.

¹³⁷ Bradley/Ford 2004, 174–177; Brück 2006, 91.

¹³⁸ Röst 2016, 220. 238.

¹³⁹ Knight 2022, 130 tab. 5.8.



Fig. 11 Selection of fragments with fitting counterparts from Late Bronze Age hoards. – 1 Aluniș. – 2 Bancu. – 3–4 Cara. – 5, 7 Valea Largă. – 6 Vădaș. – 8 Mociu. – 9–11 Crăciunești. – 12 Popești. – 13 Ormeniș. – 14 Merești I. – 15 Țigău. – 16–17, 20 Suseni. – 18 Călugăreni. – 19 Rebrîșoara II. – 21 Uriu. – 22 Perișor. – 23 Vâlcele II. – 24 Predeal II. – 25 Cenad. – 26 Pir. – 27 Căpușu de Câmpie. – 28–29, 33 Tăuteu. – 30 Fânațe. – 31 Moigrad. – 32 Suatu. – 34 Silvașu de Câmpie. – 35 Hida. – 36 Glod. – (1–3, 6, 12, 15–18, 20–23 photos B. Rezi; 4, 13, 25, 27, 31–32, 34–35 after Petrescu-Dîmbovița 1978, pls 23, A6; 123, A1; 217, A21; 235, 19; 242, 7; 260, C2, A21; 5, 7, 8 after Roska 1942, figs 209, 12, 23; 222, 2; 9–11 after Kacsó 2015, figs 90, 2–3; 92, 3; 12 after Kacsó 1995b, fig. 1, 15; 14 after Emödi 2006, fig. 4, 1/11; 19 after Rusu 1964, fig. 2, 7; 24 after Bader 1991, pl. 36, 329; 26 after Marta 2015, 28–29 pl. 5, 3; 33 after Dumitrescu 1935/1936, fig. 2, 1; 30 after Rusu 1960, fig. 1, 9; 36 after Nistor/Vulpe 1969, fig. 4, 64). – Not to scale.

the hoards, which never obtained a permanent place in the structure of these finds. Is their lack a coincidence, or can they be somehow integrated in the general pattern of the hoarding practices or even in the fragmentation customs? For a better understanding of this phenomenon, several well-dated and representative hoards from the three chronological periods (Bz D–Ha A–Ha B1) in which fragmentation was most common, were selected, and hypothetical reconstructions of the missing parts were outlined. The main goal of this remake was not the exact typological determination but the illustration of proportions between the existing and the missing objects. The broken objects, when possible, were always completed with one single reconstructed piece, although the existing artefact could have had several counterparts as well (fig. 12). The underlying assumption was based on the speculative idea that the missing parts should or could have been hoarded as well.

Looking at the hoards of the first period, it can be noticed that the missing broken parts are usually smaller than the remaining damaged artefacts. We are dealing with small bits, which are in total contrast to the extant objects of the assemblage. Usually,

the upper or the lower part of an artefact is affected, namely the rim or the edge of socketed axes, the blade or the shaft-hole of battle-axes, or the tip of the sickles. The damage may have been caused by natural wear, as the broken bits can be the result of poor or intensive use. The majority of the absent parts can be inserted in a pattern of excessive fragmentation. From the perspective of hoarding, all these small bits represented disposable material, for which there was no need to be included. Therefore, it is difficult to find analogies from the Bz D period for such small bits with multiple breakage surfaces¹⁴⁰ (fig. 12, 1–4).

In the upcoming evolution phase the image of the »missing hoard« changes with the alteration of the fragmentation patterns. Due to the increased number of artefacts, the high typological variety and the increased fragmentation, the reconstructed parts become more diverse as well¹⁴¹. The similarity between the actual hoard and its missing counterpart is noticeable immediately. There are hardly any object types which are not fragmented to some degree and the reconstructed pieces correspond typologically and proportionally to the existent objects. If one would separate the remaining hoard from its coun-

¹⁴⁰ For example, see the hoards from Bătarci (Satu Mare County/RO) (Kacsó 2017, figs 10, 5; 11, 11–13), Lepindea (Mureș County/RO) (Roska 1942, fig. 171, 2), Perișor (Bistrița-Năsăud County/RO) (Soroceanu/Retegan 1981, fig. 20, 10, 12–15) and Valea Largă (Mureș County/RO) (Roska 1942, fig. 209, 22–24).

¹⁴¹ Only a few broken objects from the Vâlcele II hoard (Cluj County/RO) could not be reconstructed, due to their severely damaged condition or ambiguous typology: a sword blade, a knife handle, a small bronze wire (maybe a needle) and a belt fragment.



Fig. 12 Hypothetical reconstructions of damaged artefacts from different chronological periods. – 1 Cara. – 2 Uriu. – 3 Rebrîșoara I. – 4 Rebrîșoara II. – 5 Vâlcele II. – 6 Tăuteu. – (1, 1–3, 6–7; 2 photos B. Rezi; 3–4 after Rusu 1964, figs 1–2; 5 after Soroceanu 1981, figs 1–4; 6 after Dumitrescu 1935/1936, figs 1–6 and Petrescu-Dîmbovița 1961, figs 2–3, 5; graphics B. Rezi). – Not to scale.

terpart and designate them as two distinct finds or integrate them in other contemporary assemblages, no one would ever notice. Due to the peculiar fragmentation patterns of the period, the reconstructed bits have a more defined outline and integrate entirely in the typological diversity of the Ha A time span (**fig. 12, 5**). This suggests that the increased metalwork that characterised the 12th–11th centuries BC and the excessive hoarding that followed, may have

been the result of a rethought or reinterpreted alternative use of the discarded metal. In this sense, the previously formulated hypothesis that in addition to ritual, social hoarding or *pars pro toto* interpretation, the use of fragmented metal in other assemblages is also likely, cannot be completely ruled out.

Towards the end of the Ha A period the perception of the »missing hoard« changed again. Not only are the artefacts typologically consistent with a

Ha B1 dating¹⁴², but the intentional deterioration of the artefacts is significantly reduced. During Ha B1 the majority of the pieces are intact. The dominant types of the period generally lack a deliberate manipulation, a situation comparable to the hoards of the Bz D period. In most assemblages pieces similar to the missing bits were rarely integrated (**fig. 12, 6**). Recently, it has been suggested that in the first two stages of the Late Bronze Age (Bz D–Ha A) the fitting counterparts of the broken objects rarely ended up in the hoards, which is emphasised even more by the fact that the number of artefacts had reached its climax. Lately it has been argued that in the Ha B1 period the broken but complete objects were commonly buried within single hoards, thus contrasting with the earlier assemblages¹⁴³. Recent finds from northern and north-western Hungary have confirmed this assumption¹⁴⁴.

Thus, it is presumable that two kinds of hoard images existed during the Late Bronze Age, which changed over time: firstly, there is the »visible side of the hoard« and secondly the counterpart of the same archaeological legacy, namely the »missing hoard«. During the Bz D and Ha B1 periods, the two images are in total contrast to each other, they can be very well separated from each other, and the missing hoard, as a specially and purposefully structured find never occurs on its own. Throughout the Ha A period, which represents the peak of the Transylvanian hoarding activity with thousands of broken artefacts buried, and due to the scrap hoard character and the longer accumulation period, the missing artefacts may be organically integrated in other finds as well, and one cannot exclude the possibility of finding two different fragments from two different hoards which can be fitted together (similar to the sword from Hanford and Trentham/GB)¹⁴⁵. This double image of the Late Bronze Age

hoarding can be seen as a special kind of custom, where the existing and the missing parts may have played different roles, and it is admissible that not all parts of an artefact may have had the same value¹⁴⁶, as not all damaged and/or detached bits and pieces were meant for metallurgical recycling. It was previously assumed that particularly in areas where scrap hoards occur frequently, it would appear attractive to investigate the extent to which the fragmented artefacts may have been divided into several ensembles and the fragments were further adapted. A truly groundbreaking future research would be the attempt to refit different fragments from distinct hoards, which would shed new light on the impulses behind the practice of fragmentation. Regardless of its ritual or metallurgical motivation, the fragmentation of objects was implemented at the points where it was easiest to do so and most of the time left no traces at all. Therefore, the technical breakage alone is not sufficient as a template for interpreting the finds as a storage depot¹⁴⁷. From our perspective this is the case of the Ha A period, during which the upswing of hoarding may be explained through a specific and purposeful usage/re-usage of the broken bits.

Still, it is impossible to identify the possible destination or function of the missing parts. Our presumption was based so far on the hypothetical idea that the missing parts ended up in the ground as well. If the fragments were not meant for deposition, their absence can be explained in many different ways. To mention just a few examples, some argued that many scrap pieces may have been destroyed during the recasting process¹⁴⁸; the hoards were accumulated over a longer period of time and older or newer pieces may have been repeatedly taken out or added, either because of pre-monetary or metallurgical considerations¹⁴⁹; they were transported

142 The exact chronological position of the Romanian Ha A2 hoards is still unsolved and problematic. Due to obvious constraints, it will not be discussed here. For a European perspective of this issue, see Tarbay 2015a, 329–332.

143 Marta 2015, 274 note 12; 278–279; 2017, 204–205. In L. Marta's opinion this trend is noticeable mainly within hoards recovered in the last few years by using metal detectors, suggesting a deficient professional/archaeological recovery for the hoards discovered in the past. See also, Szabó 2017a.

144 Szabó 2011; 2019.

145 Rezi 2011; Mörtz 2013, 58.

146 Bradley 2005, 153; Vilaça/Bottaini 2019, 133.

147 Mörtz 2013, 58.

148 Huth 1997, 180–181; 2009, 44; Sörman 2024, 268.

149 Needham 2001, 287–291 fig. 7; Bradley 2005, 151; Falkenstein 2013, 92–95, with previous literature; Wiseman 2018, 45; Szabó 2019.



Fig. 13 Recontextualized items from Bandul de Câmpie. – 1 Re-sharpened sword. – 2–3 Combined items of undetermined function. – (After Soroceanu et al. 2017, pls 89, 1; 96, 27–28). – Not to scale.

over long distances or were moved from the original hoarding place¹⁵⁰; two persons or communities distributed the fragments between each other, or even an individual could have kept the missing part for himself¹⁵¹, etc. Evidently fragments could have had various uses. Whichever of these theories we accept, based on what has been recovered from the ground, it is certain that the vast majority of fragments lack their matching counterparts. Whether the damaged bits were disregarded before or during the moment of hoarding it is often very hard to determine, especially if the breakage line does not show noticeable wear.

However, the value of an artefact is not measured solely by its material and functional properties, but always in relation to the ideological connotations of its users¹⁵². The special function of the broken items is expressed by those exemplars where the initial function of the objects was reconsidered, transformed. Almost 20 years ago it was proposed that »objects were regularly deliberately fragment-

ed, and the resulting fragments were often re-used in an extended use-life after »the break«¹⁵³. It has recently been argued that modified and reused bronze metalwork underpins the choice of keeping it instead of simply re-melting and casting it into new objects. The multitude of highly visible repair marks suggests that similar objects were accepted or even appreciated and their inclusion in different depositional contexts was considered appropriate¹⁵⁴. Exceptional biographies are certified by individual fragments or items which were reshaped and re-used for different purposes¹⁵⁵. Such objects may offer therefore an important insight into the life of fragments after the moment of break.

A suggestive example in this regard is a Rixheim type sword from the Bandul de Câmpie hoard which was hammered and re-sharpened most probably after the blade had suffered a significant deterioration. The object obtained is a small, scraper or knife-like item, which served a totally different purpose than the sword (**fig. 13, 1**). Its importance lies in the geo-

¹⁵⁰ Chapman 1996. Another suggestive example is the hoard from Kainischthal (Steiermark/AT) with impressive time and geographical difference between accumulation and hoarding. In this regard, see Hansen 2016, 196.

¹⁵¹ Chapman 2000, 63–104; Nebelsick 2000, 169–170; Hansen 1994, 360; Țârlea 2008, 88–89; Brück 2016, 82–83; Hansen 2016, 200.

¹⁵² Mörtz 2013, 62.

¹⁵³ Chapman/Gaydarska 2007, 2. 8–10. 18.

¹⁵⁴ Ojala/Sörman 2024.

¹⁵⁵ Fontijn 2013; Kienlin/Widura 2014; Kienlin/Kreuz 2015, with previous literature; Knight 2022, 140; Sörman 2024, 262.

graphical and cultural connections, being the most eastern specimen of the type known so far. We will never find out whether the breakage was accidental or not, but the remaining artefact was used afterwards till the moment of deposition, thus offering a glimpse into its cultural biography and highlighting its social significance. Perhaps the known distant and/or western origin nourished its importance and contributed to its prolonged life. Similar procedures were attested for broken socketed axes which were transformed into socketed hammers¹⁵⁶, for broken sickles that were transformed into knives¹⁵⁷, for spearheads used after the loss of their tips¹⁵⁸, or for bronze belts that were reshaped and used as funnel-shaped pendants¹⁵⁹ or double perforated buttons¹⁶⁰.

Among the nearly 2800 artefacts from Bandul de Câmpie, two very special items should be emphasised, which are in complete contrast to the general picture of the hoard: several bronze sheets and a casting remain were placed on top of each other and wrapped with a thin bronze wire (stretched out

saltaleoni) like a tiny gift. The second is the total opposite of the previous one, containing bronze wires wrapped in thin bronze sheets (**fig. 13, 2–3**). These items clearly exceed the daily or mundane sphere of metallurgy and point to a twofold reinterpretation of objects. First of all, the design of the first stage, namely the construction of the small »packages« is the recontextualisation of several object types, such as belts, spiral tubes and casting remains by creating a »miniature hoard« as defined by O. Dietrich and T. Mörtz¹⁶¹. Perhaps the opposite character of the items was taken into account as well¹⁶². Secondly, the two bundles were buried next to an ensemble of objects with an extremely strong metallurgical connotation, having especially an ideological meaning. Thus, one can ask the question whether the small packages lost their second meaning too, or the character of the hoard was appropriate to accommodate such objects? Either the small bundles were devalued and destined for re-melting, or the entire nature of the hoard surpassed a simplistic metallurgical or scrap material pile.

Closing Remarks

First of all, it has to be stressed that the theory of deliberate fragmentation cannot exhaustively explain the presence of all broken objects. Natural usage marks, unintentional prehistoric breakage and even modern day alterations must be taken into consideration. The morphology of the fragments is determined by the thickness, inner structure and shape of the object and also by the strength of the mechanical effect. Therefore, fragmentation is not always the result of an intentional act¹⁶³. Detailed analysis of objects¹⁶⁴, or extensive field surveys carried out

with metal detectors¹⁶⁵ have proven that the general picture of fragmentation customs can change in the future. Furthermore it has been argued that the motivation behind fragmentation and deposition can have distinctive explanations as well¹⁶⁶. What is more, copper-alloy hoards are only the »end products« of a complex chain of acts, and therefore the true meaning and motivation behind their concealment is impossible to decipher. It is for this reason that sharp conclusions should be outlined only with caution.

¹⁵⁶ In the Șpălnaca II hoard the breakage line on a socketed axe was hammered forming a new rim, which then suffered a second deterioration. In the hoard from Uioara de Sus, a similar axe broke at the socket area, but the breakage surface shows clear traces of usage. See Dietrich/Dietrich 2013, 199–200 figs 3. 5.

¹⁵⁷ Mozsolics 1985, pl. 246, 16. The damaged blade was even perforated to facilitate a better hafting.

¹⁵⁸ Tarbay 2019, 276–278.

¹⁵⁹ Emódi 2006, pl. 7.

¹⁶⁰ Patay 1966, pl. II, 3–7.

¹⁶¹ Dietrich/Mörtz 2019.

¹⁶² Regarding the duality of objects and hoards during the Bronze Age, see Soroceanu 2011b; Tarbay 2022, 149–165.

¹⁶³ Chapman 2000, 23; Clausen 2003, 127–129; Huth 2008, 138; Tarbay 2015–2016, 102; 2017, 83; Gentile/van Gijn 2019.

¹⁶⁴ Horn/von Holstein 2017; Tarbay 2017.

¹⁶⁵ Szabó 2011; Marta 2017, 204–205; Szabó 2017b; 2019.

¹⁶⁶ Needham 2001; Mörtz 2013, 55–59.

In interpreting fragmentation, the everyday metallurgical or economic reasons are frequently discussed separately from the social, religious motivations¹⁶⁷. The multitude of scrap material within large assemblages is often defined as »reversible« or »open hoards«, giving way to the possibility that their objects may have been manipulated periodically by individuals or a community¹⁶⁸. It has been further argued that the fragmentation of scrap bronze assemblages was driven primarily by the utilitarian necessities of metal recycling, with no real evidence of purposeful selection and that their burial must have been only temporary¹⁶⁹. In the last few years, a series of discoveries from eastern and north-eastern Hungary have been unearthed systematically within settlements. Sets of various artefacts, intact, broken or damaged pieces, casting waste and bronze cakes were buried, representing tangible parts of a household's wealth. These accumulations were defined as »treasures lying heaped« which may have functioned as a reserve that could be used as weapons, as working tools, or as currency in practical or ritual transactions. Having an »open« character, they may have been enlarged, but certain items may have also been removed if needed. Such bronze reserves were accumulated during successive generations¹⁷⁰.

Nevertheless, the majority of the damage marks are prehistoric and intentional, and the character of broken swords, spearheads, socketed axes, sickles, etc. within these finds point to a symbolic process prior to hoarding. As such, the differentiation between sacrificial or profane depositions, wet versus dry depositional contexts may be variations on the same theme rather than opposite categories, as the context of the hoarding itself may suggest a symbolic nature¹⁷¹. The worn character of at least some of the fragments, the transformation and re-use of others, or the inclusion of as-cast objects in the hoards point to special and meaningful biographies

prior to deposition and highlight the peculiarity of hoarding.

Thus, the diversity of fragmentation practices and their structural contexts point beyond the idea that breaking was performed in order to recycle¹⁷². All the above presented data has confirmed that the practice of fragmentation in the Eastern Carpathian Basin is geographically and chronologically defined with clear alternating patterns throughout regions and time. Similar patterns, which took into account very specific structural and damage standards across the ages, have been observed in many areas of Europe¹⁷³. Hoards from the Eastern Carpathian Basin dated to the Early and Middle Bronze Age exhibit only usual use-wear marks. The scarce deteriorations on the blades of swords, axes, and spearheads point towards a regular use. Assemblages such as the one from Cernat-Hegyes can be considered unique discoveries. As it was highlighted by previous studies, in the eastern parts of the Carpathian Basin the deliberate manipulation as a purposefully executed action, appears in the first stages of the Late Bronze Age, and reaches its culmination in the Ha A period¹⁷⁴. Although the number of hoards diminished, the number of artefacts and the weight of the buried metal reached unseen proportions. The fragmentation was applied to every object type with very few exceptions. In the Bz D–Ha A periods different regions acquired distinctly structured hoards, and the deterioration of the artefacts was adjusted accordingly. Hoards from the Criş river's area display a very specific fragmentation pattern, with seemingly intact objects, but with a mixed and diverse structure. The deliberate breakage of the composite ornaments can be stressed by the missing counterparts of the clothing accessories. In the upcoming stages, the intensity of the fragmentation practice was much reduced. In spite of the fact that broken objects are present in hoards, the wilful manipulation of the

167 Sommerfeld 1994, 31–33; Mörtz 2013, 59–60; Brandherm 2018, with previous literature; 2019.

168 Needham 2001, 288–289; Bradley 2005, 151; Huth 2024. Regarding the topic of »irrecoverable hoards«, see Turk 2024.

169 Wiseman 2018. See also Huth 2024, 30–32.

170 Tarbay 2017, 83–84; Szabó 2019, 115–116. 125–126. 137; Tarbay 2021, 117.

171 Brück 2016; Fontijn 2019; Sörman 2024, 261–262.

172 Vilaça/Bottaini 2019.

173 Hansen 2005; Maraszek 2006; Vachta 2016, 98–103 fig. 5; Tarbay 2021, 122–125; Knight 2022.

174 The publication of the hoard from Noşlac might be able to change this perspective in the near future.

items was not so pronounced in the upcoming periods.

Looking at some of the objects, it is undeniable that several damaged and totally destroyed artefacts are mostly the result of a premeditated and intentional action, sometimes showing the entire fragmentation process an object has been exposed to. The bending as a final stage of the fragmentation is characteristic of the Ha A period, being used mainly on bladed objects. It can be observed on other object types as well, being a preceding stage of the breakage. Similarly, the multiple breakages on one object are clear traces of the conscious and planned action. After the first fragmentation, the artefact was not repaired, it was not neglected, instead it was continuously broken to smaller parts. It is clear that in many cases, the fragmentation was not the result of a repeated smashing action over a longer period of time, but it was a well-planned, onetime event. The objects do not seem simply broken, instead they are systematically cut into pieces. In many instances, a seemingly violent and manipulative behaviour is more than obvious over the formal destruction of objects.

Having geographical and chronological variables, and seen as a general practice, fragmentation seems more difficult to be linked to metallurgical necessity or explanation¹⁷⁵. The process of re-melting and casting, the use/re-use of the scrap material, the manufacturing of new objects, would have required mainly the same technology throughout time. Given the general context offered by the hoarding phenomenon itself, it is highly probable that the objects were meant to be excluded from the general metal circulation forever¹⁷⁶. The seemingly chaotic structure of the finds, mostly from the first stages of the Late Bronze Age, correlated with earlier and later assemblages, testifies that the objects were not randomly selected. A repetitive choice of objects for deposition is clearly recognisable and the composition of the hoards' content was based on a social consensus as

to what was regarded as worthy of deposition¹⁷⁷, or which was the »right« way to treat objects¹⁷⁸. In this regard, it seems probable that the social value of the deposited material surmounts any economic or intrinsic value it may have had during its lifetime¹⁷⁹. As such, hoards with all their specific characteristics, including fragmentation, can be considered an outcome of »cultural remembrance« carried by individuals but influenced by the community¹⁸⁰. The extent to which people in the past made their own conscious decisions which empowered them in their social world or, alternatively, followed their forms of habitus with little personal decision, is difficult to estimate¹⁸¹. Through their reminiscent character, the fragmentary objects had a more accentuated social role than simple materials with recycling potential¹⁸².

Furthermore, even the moment or the timing of fragmentation in relation to deposition raises serious questions. Were the objects fragmented during their lifetime or were they broken into parts right before or in the moment of the hoarding? If one cannot find clear wear marks on the breakage lines, or if the fragmentation was carried out with the hot-shortening technique, it is almost impossible to answer these questions. The main goal of the fragmentation was to deprive the artefact of its daily or symbolic function¹⁸³, and thus prevent everyone from future use. Several individual acts or even ritual activities could have been carried out, some of them could have happened long before the act of deposition itself¹⁸⁴. The selection of the object, the treatment applied and the chosen place may have influenced altogether the outcome of the fragmentation and ultimately that of the deposition¹⁸⁵. Similar ideas are supported by dozens of artefacts which were altered and re-used after a serious damage, confirming that not every broken object ended up in a hoard. The frequency of such items in comparison to the large quantity of bronze deposited is extremely low. Anyway, the fragmented items would have lost their original util-

¹⁷⁵ Hansen 1991, 162; Bradley 2007, 201.

¹⁷⁶ Huth 2008, 142-143; Hansen 2016, 189.

¹⁷⁷ Fontijn 2005, 149-151; Hansen 2012, 128-129; 2016, 198.

¹⁷⁸ Fontijn 2019, 26-29; Knight 2024.

¹⁷⁹ Fontijn 2019.

¹⁸⁰ Vachta 2016, 101-103.

¹⁸¹ Chapman 2012, 132.

¹⁸² Țârlea 2008, 88.

¹⁸³ Melheim/Horn 2014, 18.

¹⁸⁴ Tarbay 2017, 83; Knight 2022, 141.

¹⁸⁵ Knight 2024, 252-253.

itarian purpose, and a particular use-life cycle would have definitively ended and become irretrievable¹⁸⁶. Through fragmentation, a new meaning could be created for the broken objects, without stripping them entirely of their significance¹⁸⁷. For some the deliberate destruction of both people and artefacts acted not only as a means of transformation but was considered essential to the regeneration of life in the face of death. Thus, the hoarded broken metalwork may have represented a mirror of the human life cycle¹⁸⁸. In addition, the objects were deposited with the intended act of burial and were never retrieved¹⁸⁹. Therefore, the destruction of objects has

to be analysed in relation with the deposition, the two phenomena forming one ritual sacrifice¹⁹⁰. It is less likely that the deliberate manipulation expressed through multiple slicing and bending could have happened in the midst of an object's normal life cycle. Without re-using and re-casting the broken bits, they were no longer incorporated in the economical circuit of the period. Taking all this into consideration, but knowing that every deposition is a unique prehistoric act, we believe that the practice of fragmentation can be more easily linked to the moment of deposition, being adjusted according to the general spacetime trends of hoarding.

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¹⁸⁶ Needham 2001, 289; Fontijn et al. 2012, 209–210; Fontijn 2019, 119–120.

¹⁸⁷ Dietrich 2014, 482.

¹⁸⁸ Brück 2006; Brück/Fontijn 2013, 207–209.

¹⁸⁹ Hansen 2016, 186.

¹⁹⁰ Horn 2011, 54–61.

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Fragmentation Patterns and the Late Bronze Age Deposition at Ingolstadt-Dünzlau

ABSTRACT

The paper deals with the Late Bronze Age deposition at Ingolstadt-Dünzlau. It consists of over 1,800 objects weighing approximately 34 kg, making it the largest deposition from the Urnfield period in southern Germany. The hoard consists of a wide range of objects, which in 97 % of the cases are fragmented. A current doctoral student at the University of Freiburg is researching the hoard, during which the recording of the deposition including dimensions and professional pictures could be finished. With this dataset, the typological features and weight-patterns of the hoard can be accessed. In addition, it offers the possibility to investigate the fragmentation and destruction of bronze objects within Late Bronze Age hoards. Recent research has proposed some ways to deal with the phenomenon. Concerning the deposition, the paper shows where there are difficulties and opportunities for adjustment. The aim is to outline how the data offers clues about the hoard and which methods can be applied in order to do so.

KEYWORDS

Dünzlau hoard | Late Bronze Age | hoards | fragmentation analyses

With the discovery of the deposition at Ingolstadt-Dünzlau, it quickly became clear that this hoard, with a weight of approximately 34 kg and a total amount of around 1,800 objects, represents the largest known deposition of the Late Bronze Age in southern Germany.

Like most extensive hoards of the time, it consists of a collection of many, sometimes very small, fragmented bronze and copper objects. Due to the professional and contemporary documentation of the deposition, it differs, apart from its size, from the other deposits known from Bavaria, which are mostly from old finds. This offers an incredible opportunity for a better understanding of the group of finds through thorough analysis. However, the very good starting point requires a consistent approach to the investigation in order to illuminate aspects of

the deposit relevant to its interpretation. Through documentation, qualitative analyses of typology, deformation of fragments and dating are feasible. These are also reliable due to completeness. Quantitative statements on weights, sizes, and fracture frequency are possible due to the number of objects and the representative object forms and quantities. This paper aims to present the analyses carried out as part of the underlying ongoing doctoral project. Initial results of the investigations and evaluations are used to characterize the deposition. A particular focus is on the examination of fragmentation. Since a uniform documentation standard has not yet been achieved, various existing and new approaches to describing fragmentation in the hoard are applied. This approach also suggests statements about the causes of fragmentation.

Location and Discovery

Ingolstadt-Dünzlau is located in Bavaria in the Danube valley, around 4 km from the modern Danube. A doctoral thesis by Fabian M. Wittenborn enabled a reconstruction of the Ingolstadt region in the Urn-field period (Wittenborn 2021), including the palaeo-hydrological network (Arauner 2014) and the local vegetation (Peters/Peters 2011).

The groundwater levels show that the archaeologically preserved finds all come from flood-free stretches of the high terraces. This includes the deposition of Dünzlau. There were no traces of settlements or grave finds in the immediate vicinity of the hoard (fig. 1).

The deposition was found very close to the surface, which has been in long-term agricultural use. Since a such land-use makes it unlikely to find remains of some other structures close to it, it cannot be said for sure that there were no associated archaeological remains. During the investigation of the Ingolstadt area by Wittenborn, settlement areas could already be defined. According to the author, the area defined as an independent region was apparently little used

despite intensive archaeological investigation. Only through single find spots can a probable use of the area be suggested. All these belong to the period of Bz D–Ha A1. This is likely due to the fact that the Buxheim region (Lkr. Unterallgäu/DE) to the north was better suited for agricultural use, because of its loess soils (Wittenborn 2021, 294–295).

The first objects of the hoard were discovered by Michael Ernst, a metal detectorist, in 2014. Because of his exemplary action of reporting the find early, professionals could carry out the excavation. The main part of the hoard could be excavated *in situ*. The objects were found at a shallow depth of about 15–45 cm and very close to each other. This indicates that they were inside a container made of organic material, which is no longer preserved. The excavation took three days. During the first two days, professionals excavated the deposition. The second step was to search the surrounding area with metal detectors to detect stray finds. This showed that some objects were already dislocated through ploughing, as is visible in the excavation plan (fig. 2).

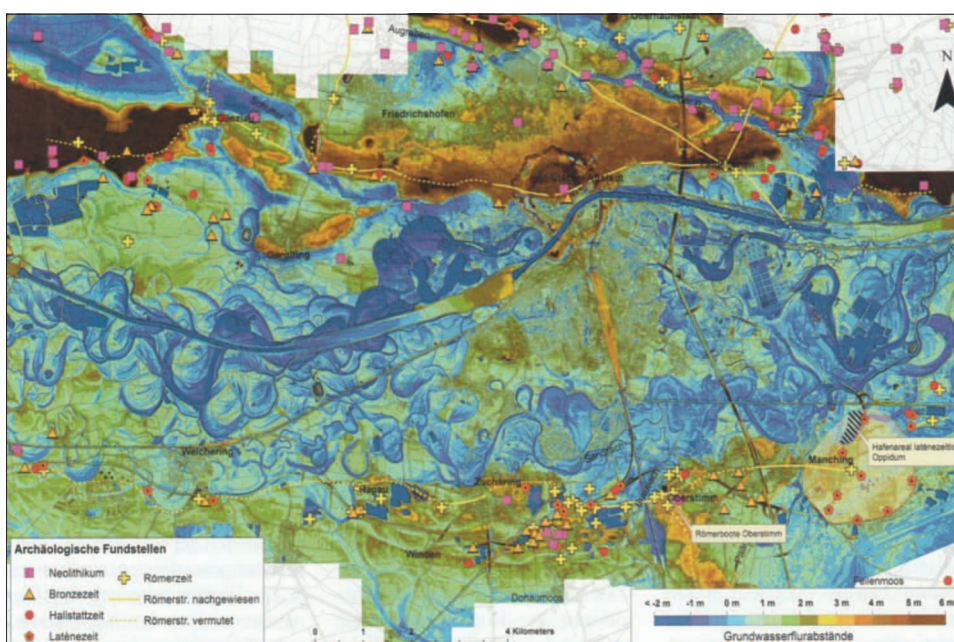


Fig. 1 Map of the Ingolstadt region with indicated groundwater levels and vegetation. – (After Arauner 2014, 136 fig. 6).



Fig. 2 The Dünzlau deposition *in situ* during the excavation, planum 3. – (Photo Th. Richter; courtesy of Archäologische Staatssammlung München).

Typological Study

For the typological study, the objects have been sorted according to functional groups. The functional groups are weapons, tools, raw materials, and jewellery as well as uncertain/single forms. Of the 1,828 unearthed objects, 1,781 can be identified as prehistoric; whereas 47 objects are modern remains. Of the prehistoric objects, 1,059 can be classified as clearly identifiable and thus belong to one of the aforementioned categories. The remaining 722 objects could also belong to other categories and have been classified as ambiguously identifiable objects, or indeterminate. The numbers of objects and object fragments in the functional groups are summarized in **table 1**.

For closer identification, the objects from the functional groups were classified into standard archaeological categories. These are further divided, depending on the author and state of research,

sometimes into classes, types, and variants, sometimes into classes and types, and sometimes into types and variants. Re-attribution of the typological designations of the authors was done only in exceptional cases. This paper uses the hierarchical levels: functional group, category, class, type, and variant to use as many existing, unchanged typologies as possible. In summary, the objects and object fragments of the functional groups were divided into a total of 19 categories. Additionally, it was possible to determine 61 classes, 157 types, and 66 variants.

For the description of the object types the paper presents the types in order of the following functional groups: jewellery, tools, weapons and raw material.

The determination of the objects' origins cannot be conducted for a significant amount of the objects in the deposit. This is partly due to fragmentation

	Number of objects	Weight in gramm
ornaments	452	5,349
shin-guard fragment	280	2,569
arm ring fragment	63	1,302
pin fragment	38	628
arm spiral fragment	17	483
double-spiral pendant fragment	2	175
pendant fragment	45	150
belt fragment	7	41
tools	313	11,421
axe fragment	51	5,602
sickle fragment	218	4,802
casting mould fragment	3	423
knife fragment	27	294
chisel fragment	12	290
razor fragment	2	9
raw material	200	9,437
bun-ingot fragment	165	9,007
casting debris	35	429
weapons	94	3,073
sword fragment	45	1,914
spearhead fragment	35	840
dagger fragment	12	209
spear fragment	2	111
undetermined	722	4,354
modern/not prehistoric	47	376
	1,828	34,009

Tab. 1 Summary of the numbers and weights of objects within the Dünzlau deposition, sorted by functional groups. – (Table J.-M. Skolaut).

and partly to widely distributed types. Excluding these objects, distribution areas could be researched for 661 objects. Most object fragments (n = 373) represent regional facies. Those derive from the functional groups jewellery, tools, and weapons. The raw material, represented by bun-ingots and casting residues is not considered because it can be found in Late Bronze Age deposits throughout the whole of Central Europe. However, the objects do not provide information in a typological matter. Only through trace element or isotope analysis of the respective copper

objects information on provenance could maybe be provided (Lutz et al. 2019, 363–371). The main distribution area of slightly fewer than three-quarters of the object fragments (44 % or 288 pieces) lies outside the region. Most of these belong to jewellery, whilst weapons and tools are mostly known from regional contexts. The summary and contextualization serve to sketch possible influences on the hoard inventory and as a basis for dating the deposit in the Late Bronze Age. The following paragraph discusses the hoard's chronology and spatial connections.

Jewellery

Decorative objects are the most frequently represented group of objects. However, it is not possible to address all of the objects typologically, since the objects have been fragmented. In the case of shin-guards, arm or leg rings, pins, and pendants, spatial focal points could be determined and compared with those in the Dünzlau hoard. Additional examination of the jewellery shapes reveals some anomalies in distribution and chronology for certain groups.

For the shin-guard fragments, the two classes with coiled wire and with opposing end spirals yield different results. The first group has significantly more representatives (163 object fragments). These types can be dated to the early to middle periods (Bz D–Ha A2), with a focus on the older to middle Urnfield period (Ha A). The representatives of this form likely originate from areas northwest of the find site. They are particularly widespread, especially the forms with a wide cuff, in western Germany as well as eastern and central France. Two representatives are also known from Bavaria, one from the Spalt-Stockheim (Lkr. Roth/DE) hoard, and one from Absberg (Lkr. Weißenburg-Gunzenhausen/DE) (Zöllner 1986, 97; Richter 1970, 61–64). The situation is different with the class »with opposing end spirals«. These are represented in smaller numbers in the deposit (38 object fragments) and are dated to the early to beginning of the older Urnfield period (Bz D–Ha A1). They are thus slightly earlier than the previously discussed form. This form of shin-guard probably has its origin in Bavaria, so it can be considered a regional form. This means that the older representatives of the necklaces are regional forms, while the more developed ones seem to be foreign shapes.

The situation is different for arm and leg rings. Unlike the shin-guards, neither foreign nor regional forms dominate clearly. There are 32 objects classified as regional forms and 36 as foreign shapes. 13 of the 81 objects could not be assigned. The foreign shapes are mostly concentrated in central and eastern France, with finds in Bavaria and Bohemia as eastern extensions to the distribution. The 22 fragments of rings of the Publy type represent the larg-

est part of the foreign shapes. A few more fragments possibly come from western Switzerland (4 objects). The dating of the objects shows the opposite pattern from that of the necklace fragments. The fragments more commonly found in Bavaria represent the younger forms of arm and leg rings in the hoard. They can be mainly dated to the older to middle Urnfield period (Ha A), or at least represent a more developed shape in the region. The foreign shapes belong to the older arm and leg ring types, dating to the early to middle Urnfield period (Bz D–Ha A1). For the very different and relatively few pin fragments whose distribution can be traced, a similar origin applies. However, the pins present a more heterogeneous picture. This is mainly because duplications of types are rare here. Considering only the determinable pin fragments from the 82 fragments, which include the pin head or parts of it, 32 objects remain for analysis. For most types, the Dünzlau find site must be considered the eastern point of distribution (28 objects). The distributions of the types, especially Haitz (Main-Kinzig-Kreis/DE), Wollmesheim (Landau in der Pfalz/DE), and Binningen (Ct. Basel-Landschaft/CH), are particularly represented west of the Dünzlau hoard, with a focus in eastern France and western Germany, but they also occur occasionally in Bavaria (Kubach 1977, 103. 421). On the other hand, mainly distributed in southern Bavaria are the two large-headed vase head pins. Also commonly found in contexts in southern Germany and Switzerland are the four serrated pins (Kubach 1977, 60–61). In contrast to the previously described jewellery forms, no more precise chronological depth can be determined. Except for two fragments, all objects belong to the early (Bz D) to middle Urnfield period (Ha A1). The 47 determinable pendants from the deposit are roughly divided into two groups: on the one hand, a double-spiral pendant and two fragments; on the other hand, 45 triangular pendants and related forms. The preserved double-spiral pendant fragment of the Stockheim type is richly decorated and has narrow bow plates. Other objects of this type are not common and appear in similar forms, scattered over western Germany in the Rhine-Hesse region to the northern Danube. If this loose distribution is considered a distribution area, the representatives in

Dünzlau could be described as appearing in the eastern distribution area (Wels-Weyrauch 1978, 79). The remaining 45 determinable pendants with triangular to dovetail-shaped and arm-like outlines also occur rather rarely. Especially in Bavaria, there are few representatives, which are distributed among only a few find sites. The best comparisons are found in southern and western Germany, as well as in eastern France. The wear marks in the eyelets suggest they were hung and used. The dates range from the Early Urnfield period (Bz D) to the younger and Late Urnfield period (Ha B), but no more precise chronological depth can be determined for the pendants and their fragments in the deposit. A small group of jewellery objects is represented by belt fragments. Unlike all other jewellery objects, the determinable object fragments (7 pieces) all belong to regionally represented forms. Early and later types can be dated, but only to the early to younger Urnfield period overall.

Tools

The objects classified as tools make up the second-largest number of items in the deposit. This is especially due to the numerous sickle fragments. Additionally, the axes, which account for a large portion of the weight, the typologically identifiable knives, and the few chisels are counted as tools. These objects are often too fragmented to allow for precise typological classification, but they still present a mostly uniform picture. The largest number of tool fragments consists of sickles (241 objects). Among the 66 identifiable sickle fragments, there are 26 buttoned sickles and, more frequently, 40 tongued sickles. Only the earlier types of button sickles might be considered as foreign shapes. The five representatives of the high-arched button sickles and large button sickles, especially those with base ridges and alveoli found in Dünzlau, appear in some depots in eastern France as well as in Bavaria (e. g. Cannes-Écluse, dép. Seine-et-Marne/FR; Publy, dép. Jura/FR) (Primas 1986, 72). These forms belong to the early (Bz D) to older Urnfield period (Ha A1). The regional types appear from the early to the Late Urnfield period (Bz D–Ha B), reflecting the typical

sickle development in south-eastern Germany. Possible foreign shapes are only found among the older representatives of the sickles, but since these also occur in Bavaria, they are counted as regional facies. The second-largest group of tool fragments consists of the 59 axe fragments. For all axes, as far as the fragmentation allows for typological determination, a distribution in Bavaria and neighbouring areas can be stated. However, this is only possible for 14 fragments. They all belong to the period from the early to the younger Urnfield period (Bz D–Ha B1). More precise dating is not possible due to preservation, as the typologically relevant neck parts are usually not preserved. Three socketed axe fragments with loops, one of which has a straight stop and two are of the Grigny type, frequently appear in French and foreign-influenced, south-western German depots (Pászthory/Mayer 1998, 111). They can be dated to the middle Urnfield period (Ha A2). The objects with preserved neck parts are median-winged or maybe low-winged axes.

16 knife fragments from the deposit can be reliably assigned to types and consist of two knife forms: eleven Riegsee knives and five hilt-tang knives with segmented tangs. The other knife forms are only poorly preserved in fragments. The former variant represents the largest knife stock of the Early Urnfield period and the Dünzlau hoard lies within its core distribution area. The second class has two main distribution areas: one in the Rhine-Main area and the other in Bavaria and northern Tyrol. Thus, the deposit also lies within the core distribution area, and there may be a connection to the Rhine-Main area. They can be dated to the early to middle Urnfield period (Bz D–Ha A2) (Hohlbein 2016, 229).

Weapons

The weapon fragments in the hoard include foreign shapes among the swords and possibly among the daggers. The spear fragments are generally designed more functionally during the Urnfield period, which makes distinguishing them based on form more difficult. This is also true for the objects from the Dünzlau deposit. The sword variants can be determined

and are reliable in terms of dating and distribution. Unfortunately, many objects are fragmented and the typologically distinctive handle parts are missing, which prevents a precise description of the type. Of the 61 sword fragments represented, 20 can be typologically classified. The majority consists of twelve grip-plate sword fragments, of which four Rixheim and five Rosnoën swords can be distinguished. Various variants of the Rixheim swords are present. Similarities with the Munich-Aubing sword are noteworthy (Schauer 1971, 67). Otherwise, the types of represented Rixheim sword fragments tend to be distributed more to the west of the find site up to the Iller river (Schauer 1971, 73–75). This is also true for the five fragments of Rosnoën-like swords, whose presumed origin lies in western France. However, the sword shapes as shape imports are evidenced in exceptional cases. The Rosnoën swords are early sword forms from the early and older Urnfield period (Bz D–Ha A1). The Rixheim swords belong to the same time span. The six grip-tang and three grip-tongue swords, which cannot be described in more detail due to fragmentation, are probably of regional origin and represent younger form representatives. They tend to belong to the older to the latest Urnfield period (Ha A1–Ha B1). Despite the difficult distinction between sword and dagger fragments, which mainly depends on length, twelve objects could be identified as daggers. While the grip-plate daggers, which are the most common in the hoard (11 pieces), have similar forms to Bavarian grave and stray finds. Two fragments on the other hand are widespread in France even though one of them is occasionally found in Bavaria, but can be assumed to have a western origin (Gallay 1988, 52–57. 118). The 51 spearheads from the deposit could be classified according to Říhovský, with most fragments (with smooth sockets and smooth blades) not being further delineable. Generally, spearheads are a poorly studied find category because of their functional specificity (Říhovský 1996, 3). The spearheads from Dünzlau were intensively or repeatedly used, as shown by the wear marks, which obscure the original shapes. Due to the reasons mentioned, results regarding the distribution cannot be formulated beyond stating that numerous depots with spearheads appear in Bavaria.

Raw Material

The raw material mainly consists of casting cake fragments, supplemented by casting residues. These objects total 239 pieces. The 165 casting cake fragments certainly belong to the Late Bronze Age, with the distribution north of the Alps being considered the core area (Möslein 2015, 118–120). This raw material form often appears in Bavarian depots. The typology does not provide any insight into whether the objects originate from Bavaria, as they are functional objects. The main difference from the previously discussed objects lies probably in the material composition, as casting cakes are mostly made of copper rather than bronze (Nessel 2012, 407; Modl 2010, 140). Casting residues and casting cones are also common in Late Bronze Age deposits throughout Central Europe. Due to their amorphous shape, they are not typologically distinctive and therefore have no chronological value. They are usually distinct from casting cakes in material composition, as they are bronze objects.

Single Objects

There are also more unique or special forms preserved. They do not play a major role in content comparison, so these objects will not be further discussed here.

In summary, there are regional forms for all object types. Foreign shapes do not appear in all object groups. They are particularly common among jewellery forms. Different distributions of earlier and later objects can sometimes be delineated. These are, however, successive or, at least in the case of the shin-guards, arm rings and swords, overlapping in time. When comparing foreign and regional forms, broken down by functional groups, it can be noted that weapons and jewellery represent foreign facies more frequently than tools. Raw materials cannot be evaluated in this regard, as provenance analyses for the copper of the casting cakes are not available. As to chronology, foreign shapes can be found both among earlier and later jewellery forms where iden-

tifiable. Among the swords, particularly the early representatives seem to represent foreign shapes, specifically grip-plate swords. The best comparisons for the foreign shapes are mostly distributed west of the deposit. A few objects originate from southern Germany and Switzerland, more numerous from western Germany and eastern France. This confirms a previously identified pattern in the contents of some strikingly similar depots from France, Germany, and Bohemia (Kubach 1973, 299–303; Hansen 1994, 354). Grip-tang and grip-tongue swords seem to represent regional forms, as do axes, knives, and most sickles.

The dating falls within the context of the Bz D/Ha A hoards. The forms of the Ha A2 phase play a subordinate role. The difficulties in dating hoards of broken metal have been extensively discussed, due to the heterogeneous composition of the deposits and the difficulty of comparable objects from graves

and settlement contexts (von Brunn 1968, 67; Stein 1976, 75; Hansen 1994, 306; Falkenstein 2011, 83–84; Diehm 2013, 24; Neumann 2017, 68). Although a precise chronological determination remains challenging, a relative chronological framework for the Bronze Age can be outlined, indicating a general shift in depositional practices. In the northern Alpine region, the late Tumulus Bronze Age marks the beginning of a significant increase in hoards of broken metal, which remains high into the middle Urnfield period before declining (Falkenstein 2011, 84–85). The hoard from Dünzlau fits precisely into this time frame of the Urnfield period. While a single hoard cannot provide answers to broader questions, the dating of the Dünzlau hoard supports the already formulated hypotheses regarding the temporal development of hoards of broken metal in Central Europe (Huth 2023, 138; 1997, 193–198).

Fragmentation Analysis

The first part provides all the needed information about the contents of the deposition whereas this second part will focus on the fragmentation of the objects. To shed light on the phenomenon, as much data as possible should be used. The analyses are divided into a quantitative and a qualitative approach. The qualitative analyses focus on individual phenomena concerning individual objects, groups of objects or the deposition as a whole. The quantitative analyses focus on countable features and statistics.

Quantitative Analyses

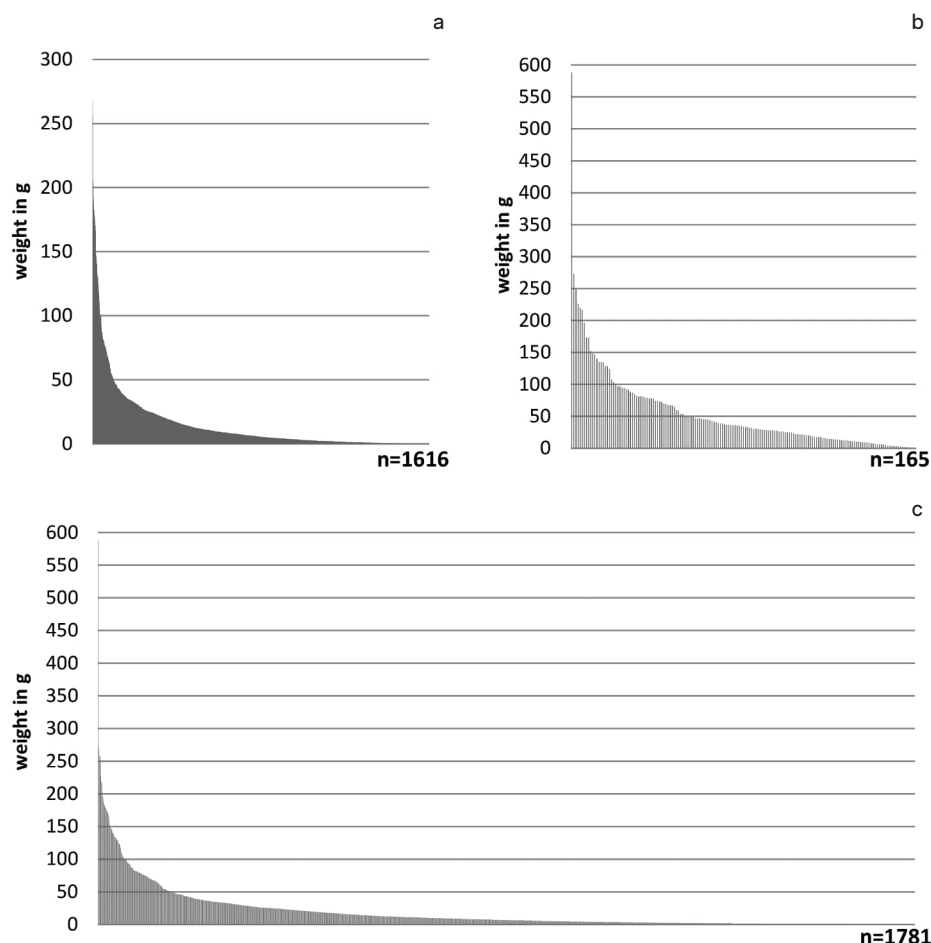
The quantitative analyses for the Dünzlau deposition concern the following parameters: weights, dimensions, number of broken edges, and the appearance of bending and deformation. Those parameters have all been documented in the inventarisation process. Before starting to analyse the potential patterns of the parameters, especially the weights and dimensions, there is an important issue to address. This mainly concerns the bun-ingot fragments. Most bun-ingot

shaped objects from other depositions consist of copper, whilst the broken metal objects are composed of alloyed metal (Wiseman 2018). Assuming that the ingots from Dünzlau follow this pattern, this would mean that about a third of the weight is nearly pure copper from only 165 objects. The other two thirds consist of alloyed metal from over 1,600 objects. Since the Bronze Age people, in their dealing with bronze and copper objects in their everyday lives most probably noted this circumstance, it should be taken in account when interpreting Bronze Age depositions containing bun-ingots. The mean length of the objects is about 4 cm, with a maximum of 20 cm and a minimum under 1 cm.

The weights of all objects range from less than 1 g up to 267 g (the latter was taken from an axe fragment) (**fig. 3a**). The presumably copper-based bun-ingots range from 1 to 590 g (**fig. 3b**). Most of the fragments for both bronze as well as copper artefacts are small and light.

The more detailed investigation of the weight and dimensions of the object fragments from the Dünzlau hoard relies on two recent studies, each using a dif-

Fig. 3 Distribution of the object weights (in g) within the Dünzlau deposition, sorted from heavy to light. – **a** Objects and fragments presumably from bronze. – **b** Objects and fragments presumably from copper. – **c** All prehistoric objects and fragments of the deposition. – (Graphics J.-M. Skolaut).

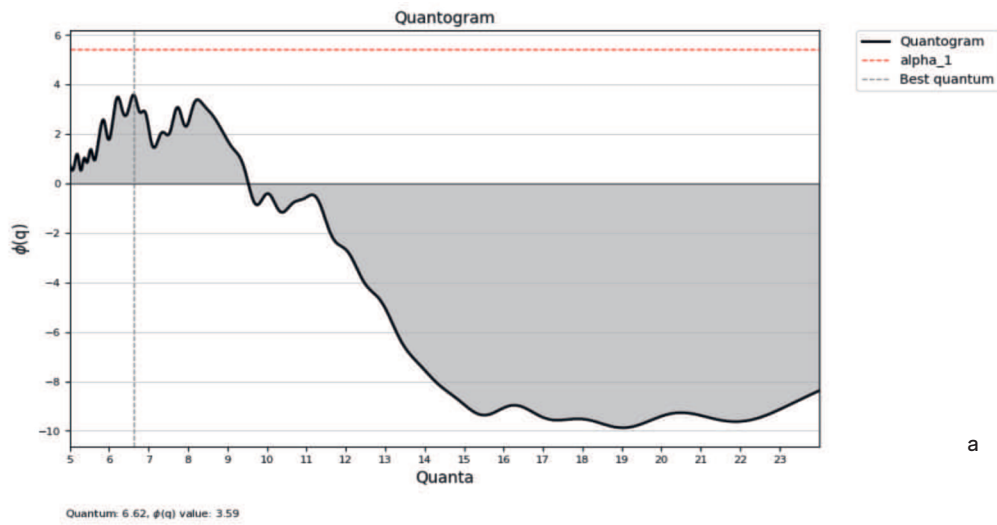


ferent statistical model (Ialongo/Lago 2021; Wiseman 2018). Since those studies investigate the weights in different approaches and interpretations, I applied both studies to the material of the Dünzlau deposition.

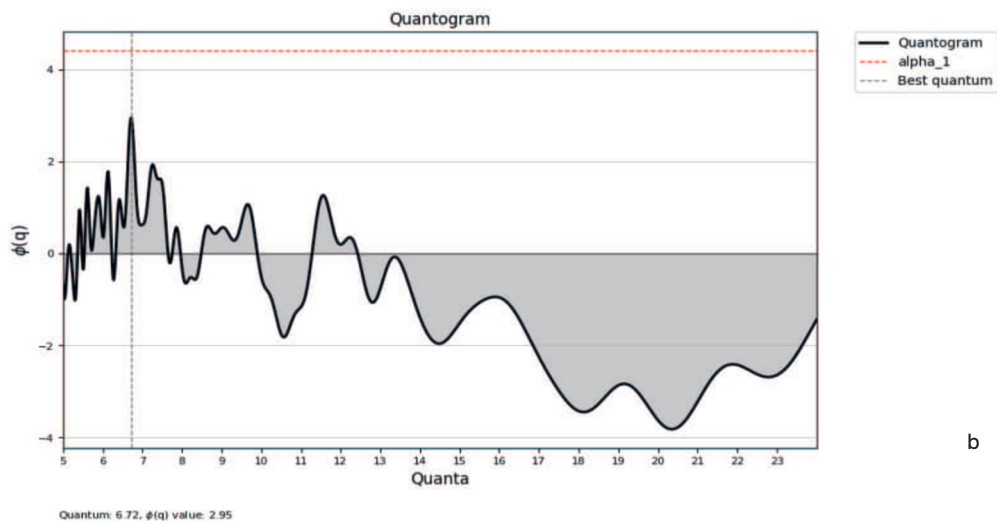
The first study that is addressed is by Nicola Ialongo and Giancarlo Lago (2021). The study analyses the weight distribution through Frequency Distribution Analysis (FDA) and following it up with a Cosine Quantogram Analysis (CQA) followed by a Monte Carlo test for statistical significance (Ialongo/Lago 2021, 6–7). Investigating objects classified as balance weights and fragments from hoards from Central Europe, the study claims to have determined a weight unit about 9.8 g (Ialongo/Lago 2021, 9). To apply the study to the Dünzlau deposition, the weights were used to create a FDA with a range of the smaller determined unit of 2.3 g. Using the provided python-package »CQArchaeo« by the authors, doing the calculations, a CQA was also applied (for details of the process, see Lago et al. 2024). For the 1,781 data samples of the Dünzlau deposition, in-

cluding the bun-shaped ingots from different material, no weight unit of 9.8 g was found. Furthermore, there were no other statistically relevant peaks in the CQA-graph showing any different weight units for the Dünzlau deposition, as proven by the Monte Carlo test (fig. 4a–c).

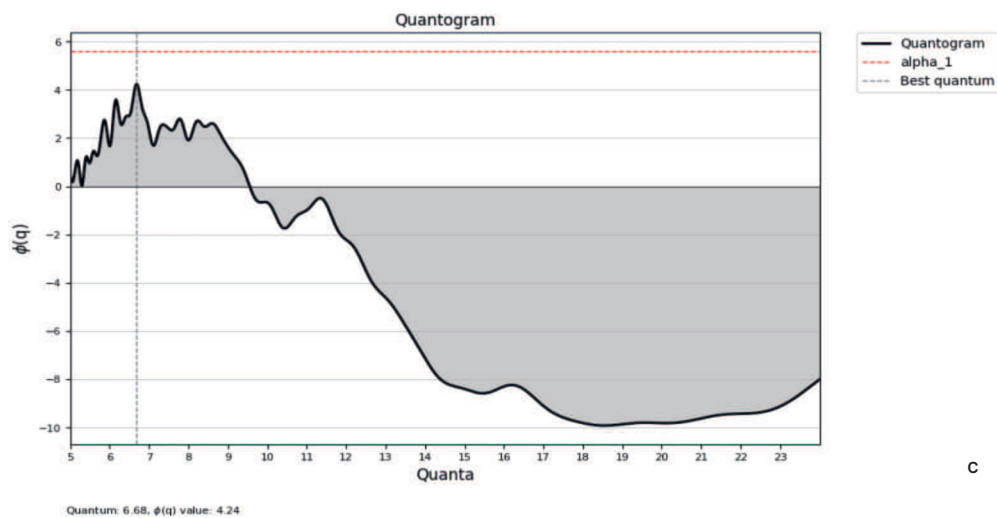
In his 2018 paper, Rob Wiseman analyses fragmentation with a different method – reversed accumulation of values (Wiseman 2018). He notes that, when sorted by size or weight, different hoards from different Bronze Age phases show the same distribution pattern. He shows that if the distribution plotted in a logarithmical scale falls onto a straight line, it means a random distribution of values (Wiseman 2018, 40–43). To apply the method to the material of the deposition of Ingolstadt-Dünzlau, the weights and the lengths were sorted in the same way. The results show that the model seems to be a good fit for the Dünzlau deposition – for the bronze fragments as well as for the bun-ingots (fig. 5a–b). Plotting individual, typological groups separately does



a



b



c

Fig. 4 CQA-graph of the object weights of the Dünzlau deposition generated by using the provided python-package »CQArchaeo«. – **a** Objects and fragments presumably from bronze. – **b** Objects and fragments presumably from copper. – **c** Objects and fragments of all prehistoric objects and fragments of the deposition. – (Graphics J.-M. Skolaut).

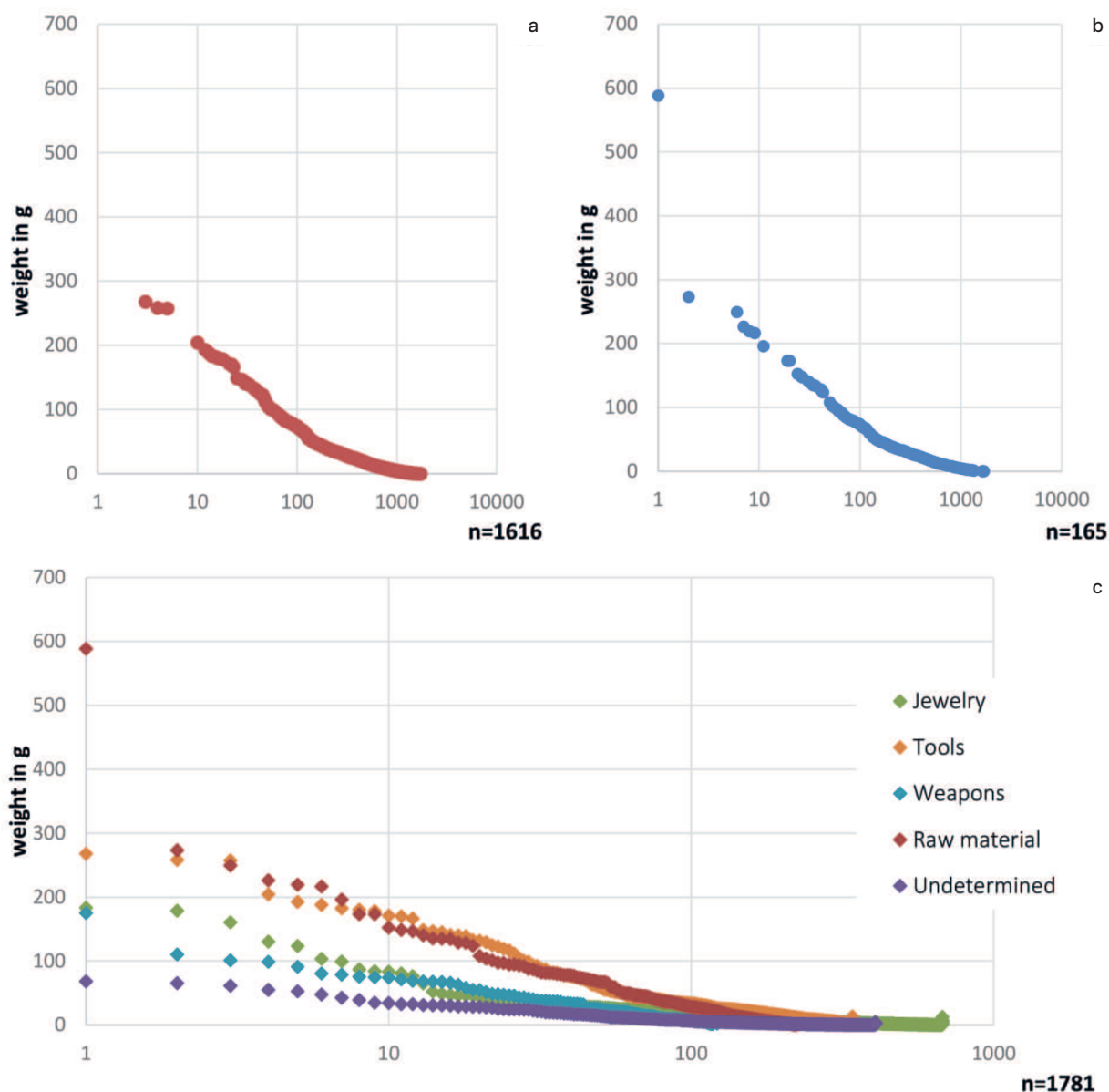


Fig. 5 Distribution of the object weights (in g) within the Dünzlau deposition in logarithmic scale according to Wiseman 2018. – **a** Objects and fragments presumably from bronze. – **b** Objects and fragments presumably from copper. – **c** Objects and fragments for the functional groups. – (Graphics J.-M. Skolaut).

not change the distribution. They even seem among themselves to have been fragmented randomly, regarding weights and dimensions (**fig. 5c**).

The data suggests that most, if not all, the objects from the Dünzlau hoard have been fragmented without the intention of proportioning according to weight or weight units. This does not exclude the possibility of metal exchanges being based on measurement of the weight of the objects with some kind

of scale using balance weights. Also, it does not give any clues about the question of whether fragmentation was deliberate or non-deliberate.

Two other parameters of the hoard contents were quantified: the number of broken edges and the presence of deformation of the objects. The number of broken edges was as high as eight breaking edges on some objects. To note the bending of objects they were compared with similar objects from the

Breaking edges	Not deformed		Deformed		All	
0	46	75.41 %	15	24.59 %	61	100 %
1	147	51.22 %	140	48.78 %	287	100 %
2	230	36.62 %	398	63.38 %	628	100 %
3	157	39.85 %	237	60.15 %	394	100 %
4	186	57.06 %	140	42.94 %	326	100 %
5	31	56.36 %	24	43.64 %	55	100 %
6	22	84.62 %	4	15.38 %	26	100 %
7	2	66.67 %	1	33.33 %	3	100 %
8		0.00 %	1	100.00 %	1	100 %
1-8	821	46.10 %	960	53.90 %	1781	100 %

Tab. 2 The breaking count in comparison to the deformation numbers including the deformation ratio (in %). – (Table J.-M. Skolaut).

same type, noting if they were deformed in a way that seems unusual.

The results are shown in **table 2**, showing how often objects have been broken and deformed. About 60 objects have no breaking edges. Most of the objects show two breaking edges followed by three, four and one breaking edge. More than four breaking edges seem to be a lot less common. The percentages of the deformation in relation to the breaking edges show that the objects broken twice or three times are deformed in about 60 % of the cases, while the ones without broken edges were deformed in c. 25 % of the cases only.

The reason for the big amount of twice or thrice broken objects lies within the distribution of object types within the deposition.

A large number of sickleblade fragments, mostly broken at the tip and the handle, results in a big number of twice broken objects. The same applies for sword fragments, shafts of pins and all long objects. More than half of the objects show deformation. A comparison of breaking edges and deformations shows that complete objects are deformed less often than objects with broken edges. The most deformations can be seen within objects with two or three broken edges. Objects with more than three edges are deformed less, because this leads to smaller fragments where deformation can either not be seen, or the objects themselves are hard to bend, like axe

heads. This also applies for the bun-ingots which have several broken edges in most cases but do not show bending. This is also the case with different metal compositions, since mostly pure copper objects are much harder to break than bronze objects, resulting in more fragmentation processes and smaller chip-pings. It is also safe to assume that breaking copper bun-ingots required a different technique and more force (Modl 2010, 135–137; Nessel 2012, 405–407). For the objects showing fragmentation and deformation, it seems that there is a correlation. On the other hand, it cannot be stressed enough that the object shapes, not always corresponding to the object types, always predetermine the way fragmentation was carried out and the presence of deformation.

Qualitative Analyses

The qualitative analyses focus on phenomena concerning individual objects, groups of objects or the deposition in whole. Regarding fragmentation, the most important observations concern individual objects and their treatment. As a basis for discussion, it is necessary to determine whether the objects' fragmentation was deliberate. To address this question, recent suggestions by Matthew G. Knight were implemented (Knight 2022).

By close examination and accompanying experiments, the author provides a »Damage Ranking System« (DRS) (Knight 2018, 213–219). This system can be used to determine if objects were fragmented deliberately or non-deliberately. It uses categories of damage ranking consisting of different indicators, ranging from 0 (definitely not deliberate) to 3 (definitely deliberate). The DRS was applied by studying every object fragment of the Dünzlau deposition individually, which resulted in the demonstration of deliberate fragmentation of the overwhelming majority of objects. A total of a further 46 objects was probably deliberately fragmented (DRS = 1–2), whereas 1,735 objects could be classified as deliberately fragmented. This means there is a good sample of fragmented objects for further study of the results and processes of fragmentation.

Up to now, pictures and drawings were the basis for the qualitative analyses. Two observations could be made. First, a lot of wear and use can be recognised on most objects. Secondly, there are bending and fragmentation patterns. The use and wear observations include ridges, notches, traces of re-sharpening, etc. All of these traces do not necessarily lead to, or derive from, fragmentation. Traces can be seen on most objects appearing in all categories and types of objects. Some studies have already addressed use-wear on copper-based artefacts (Roberts/Ottaway 2003, 120–140; Kienlin 2008, 243–249; Sáez/Lerma 2015, 171–189). Experiments, magnified pictures, chemical analyses and a much research expertise are necessary pre-requisites of those studies (Marreiros et al. 2015b, 5–26). Since there neither was the possibility to run those equipment-heavy analyses nor is the expertise of the author sufficient in this field, a detailed analysis remains as a future challenge. Nonetheless, it is very important to point out that most objects were used before deposition and, indeed, most probably before fragmentation.

The second observed fact is about bending and fragmentation patterns observed on a macroscopic scale. Some bending directions appear more often than others do. For a brief overview, some object types have been chosen to illustrate the patterns.

In the case of the sword fragments, it can be observed that, while all objects show fragmentation, only two-thirds show bending. For the bent ones, there are two recurrent ways of bending. They either show bending in one direction or in two directions. Bending in two different directions is rare and could only be observed in three cases. Bending in one direction is the case for about 30 sword fragments. Sickles fragments show comparable bending patterns: most sickle fragments ($n = 175$ or 70 %) are bent. The bending patterns are as follows: bending in the same direction in 83 cases, twisting in different directions in 64 cases and the least common bending in two different directions ($n = 14$). Most fragments from the handles and tips of the objects only show bending towards the centre of the sickle, meaning in the direction of the broken edge.

Arm and leg rings are also fragmented and bent in recurrent ways. Bending is a lot less common, but most pieces are broken. If they are bent, it seems as if they pulled in opposing direction of the open end, not pressed together. Most of the rings are unequally broken in two pieces, representing two-thirds and one-third of the object. In the case of the shin-guards, the spirals of the objects have been removed at the point where they would open up into the ornamental zone. The ornamental zones themselves have been bent and broken in different directions and many irregular pieces.

The other object types and shapes also show patterns of fragmentation and bending. Without going into more detail, they seem to follow the easiest ways to break and bent. This means the shape of the object in question seems to determine the bending and fragmentation patterns.

How this bending was achieved cannot be proven without a better understanding of the mechanical properties of the objects and their chemical composition. The observations point in the direction that bending and fragmentation were achieved through similar handling processes, depending on the objects in question. A second observation is that bending and fragmentation seem to be inter-dependent, since a lot of bending patterns could have led to fragmentation.

Summary and Interpretation

In summary, the hoard from Dünzlau represents a diverse assemblage of 1,781 fragmented bronze and some copper objects. Upon discovery, some objects had already been displaced, but their association is unquestionable. The objects found *in situ* were closely grouped, suggesting a single deposition event, probably within a container, though no trace of this container remains, indicating it was probably made of organic material. When categorized by archaeological find groups, the hoard consists of jewellery (452 pieces), tool fragments (313 pieces), raw material (200 pieces), and weapons (94 pieces). This listing must be supplemented by 722 indeterminate objects that could belong to multiple find groups but cannot be clearly assigned due to their small, fragmented nature. Among the objects are both everyday items and very skilfully crafted jewellery. The selection likely represents a cross-section of material possessions rather than a choice of objects based on quality or design. The hoard belongs to the category of mixed hoards, where the material value of the metal is more significant than the high utilitarian value of the objects (Falkenstein 2011, 76). With regard to the value, it is noteworthy that, like other mixed hoards, the bun-shaped ingots represent a large quantity of material (Huth 2023, 138). Assuming the ingots consist of copper, not of bronze like the other fragments, this should be taken into account when comparing the contents of hoards including weights and fragmentation patterns since copper has different material properties.

The objects show a high degree of mixture in terms of provenance, with items from all find groups originating from the local region, supplemented by foreign shapes, often with distribution centers west of the find site. This heterogeneous origin of the objects, along with the plurality of types, suggests a composition that reduces the objects to their material value, rather than a selection based on specific local or foreign shapes. This phenomenon can be observed in other depositions too and the Dünzlau deposition fits into the framework of scrap-metal hoards all over Europe, including the interpretation of this category of hoards (Huth 1997, 193–198; 2023, 138).

The objects date to the early to middle Urnfield period, corresponding to the Bz D–Ha A2 phases according to Reinecke. More precise dating is not possible due to the difficulties in dating these periods. The notably high degree of fragmentation is striking and thus a focus of the investigation. The majority of the objects are broken multiple times, usually two or three times, though higher breakage numbers occur. Almost all scrap objects show signs of use, which cannot always be distinguished from fragmentation marks. These marks have not been further analysed due to the complexity of the necessary analytical techniques. Numerous factors and extensive expertise are required to determine and differentiate these traces, as impressively demonstrated in the works of Tobias L. Kienlin, as well as Carmen G. Sáez and Ignacio M. Lerma (Kienlin 2008; Sáez/Lerma 2015). The use-wear on the object fragments suggests a secondary use of the objects as material for a hoard rather than a deliberate creation of the objects for deposition.

However, a thorough examination using the DRS introduced by Knight (2018) indicates deliberate fragmentation. This must have occurred independently of their use. Only 47 of the 1,781 objects fall into the category of likely non-deliberately fragmented objects (DRS = 0–2). About half of the objects are also deformed in addition to being fragmented (960 pieces), meaning they are no longer in their original shape. Quantitative studies have shown a correlation between deformation and fragmentation, as the more heavily fragmented objects are more often deformed, while the less fragmented ones are more likely to remain undeformed. This suggests a process that occurred in a cohesive, controlled manner, including the deformation and fragmentation in a related step. This makes it likely that the deformation and fragmentation steps of the objects were used to test the material properties of the objects (Knight 2022, 158–159; Huth 2023, 138).

Fragmentation experiments conducted so far have not achieved the same deformation and edge structure observed in the Dünzlau hoard findings (Lago et al. 2023, 8 fig. 7; Knight 2018, 219–221

figs 11–13). This suggests different fragmentation and deformation processes, highlighting the importance of further investigation to gain a better understanding of these processes. Other quantitative studies focused on the weights and sizes of the objects. No standardization of weight or size was found, including or excluding the bun-ingot fragments. The application of statistical tools as FDA or CQA did not yield relevant results.

An analysis using Wiseman's »Random Accumulation Theory« showed distributions comparable to those in the Dünzlau dataset, which, according to the theory, indicates a random distribution of weights and sizes, including and excluding the bun-ingot fragments (Wiseman 2018). The combined results of the two studies suggest that the fragmentation of the objects did not aim to achieve standardized weights or sizes, but rather resulted in random sizes and weights. Since no weight or size standardization within the limits of the objects in the hoard can be determined, it must be assumed that such standardization is absent. Only a significant reduction in weight and size compared to unfragmented objects can be stated. Consequently, it can be concluded that the Dünzlau hoard, if it adhered to a weight system with other Late Bronze Age hoards as previously studied by Christoph Sommerfeld and recently proposed again by Ialongo and Lago, was not integrated into this system (Sommerfeld 1994; Ialongo/Lago 2021; 2024). The reason for the fragmentation and deformation could not be further narrowed down through quantitative studies. The analyses suggest that the processes were likely controlled and did not occur during use and result in random sizes and weights of the objects. To better understand the fragmentation, the analyses were expanded to include qualitative investigations. The DRS categorization has already been mentioned (Knight 2022). Intentional fragmentation is thus confirmed for almost all objects. The qualitative investigations aim to better understand the nature of the fragmentation. Systematic fragmentation has been observed through macroscopic recordings, though this can only be determined subjectively so far. Further analyses, such as determining material composition, microstructure, and mi-

croscopic recordings of fracture edges, are needed for precise determination of the failure of these objects. An example are the analyses of sword fragments of the Slavonski Brod (Brod-Posavina County/HR) find from Croatia, which revealed the low quality and different mechanical properties of the objects (Perez Gonzales/Schwab 2023, 252. 256).

These analyses have not yet been conducted on the objects of the Dünzlau deposition but are planned for the future. The macroscopic examination of the fractures and deformations provides recurring patterns for intentionally deformed objects. These patterns align with the object forms but not necessarily with the functional groups. For example, long, flat objects like sickles and swords show similar, though not identical, deformation patterns, while massive objects like axes and ingots exhibit only slight deformation due to their massive form. In the case of the bun-shaped ingots, the assumed different material would also be relevant. Those objects aside, the similar deformations and fragmentations suggest uniform fragmentation processes. This is also supported by the previously conducted quantitative analysis of the correlation between deformation and the number of breaks.

An interesting picture of the assemblage emerges from the characteristics under analysis. The extensive hoard is heavily fragmented. Typologically speaking, all common functional groups from deposits of the period are represented in the hoard, including bronzes like jewellery, tools, and weapons, as well as copper ingots. The objects appear to have been systematically or at least in recurring processes, fragmented. These processes are adapted to the object shapes and likely do not aim at uniform measurements. However, how these processes were carried out and what purpose they served, aside from the obvious reduction in size, cannot be determined due to the lack of consistent systematization of fragmentation and deformation analyses. Developing such a systematization should play a central role in the study of the ubiquitous bronze fragments from Urnfield period hoards, as it offers the chance to understand the much-debated structures of this find group.

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Patterns of Destruction among Late Bronze Age Metalwork Depositions in Central and North-Western Europe

ABSTRACT

At a first glance, the fragmentation and deposition of metalwork seems to be an overall phenomenon of the Late Bronze Age in large parts of Europe. A closer look reveals a whole range of specific variations of both destructional and depositional practices throughout. This is particularly evident for scrap hoards on the one hand and single or multiple depositions of burnt objects on the other. Beyond fragmentation and deposition these finds do not have much in common. They differ in the way of pre-depositional treatment, in frequency and quantity, in the range of objects and the locations chosen for deposition. Although scrap hoards are very numerous and nearly ubiquitous in some regions, they are a fairly short-lived phenomenon with a peak in the final phase of the Bronze Age. The deposition of burnt and broken artefacts is much more ephemeral, but it is a practice that goes on into the Iron Age. These differences provide the best clues for a proper understanding of both economic and religious aspects of metalwork deposition and fragmentation in the Late Bronze Age.

KEYWORDS

Late Bronze Age | metalwork depositions | patterns of fragmentation | scrap hoards | lumps of molten artefacts | destruction by fire | depositional context | recycling | ritual

Archaeology is looking for patterns. With regard to fragmentation there is a very prominent pattern among Bronze Age metalwork in Europe. Beginning at the turn of the Early to the Middle Bronze Age, there is an ever increasing number of so-called scrap hoards (Huth 2024a). Scrap hoards share a whole range of distinctive features no matter where they come from. Scrap hoards contain a mixture of bronze objects old and new, or rather damaged and intact. Many if not most objects are in fact damaged. Apart from bronze scrap the hoards contain copper ingots, and besides rarely a few tin and lead ingots or lumps of molten bronze, and hardly ever any gold artefacts. Counting the objects by number, bronze scrap comes in the first place, followed by intact objects and copper ingots. Tin and lead and gold literally carry no weight. Considering the weight of the metal, copper ingots are the heaviest and therefore the most important part of the hoard (Huth/Logel

2023). As a matter of fact it seems to be more appropriate to speak about copper hoards instead of bronze hoards (figs 1–2). The scrapped bronzes have been intentionally damaged or destroyed. Breakage does not result from everyday use. Most fragments do not fit together, and joining parts are extremely rare. This does not mean, however, that each object is represented by just one fragment. Scrap as a characteristic feature of hoards appears at the end of the Early Bronze Age, when copper artefacts are being replaced gradually by bronze objects. Copper has different qualities from alloyed metal. In the first place it does not break easily. For whatever reason artefacts have been fragmented (from religious frenzy to producing standard objects for exchange to the assessment of the alloy or the processing for remelting), the type of metal itself seems to have played an important role.



Fig. 1 Scrap hoard from Fislis/Oltingue (dép. Haut-Rhin/FR). – (After Huth/Logel 2017, 881 fig. 4; 886 fig. 7; photos Th. Logel).

The climax of scrap metal deposition is generally reached at the end of the Bronze Age, i. e. earlier in Southeast and Central Europe and later in the west and northwest. While the maximum of Bronze Age hoards occurs around the 13th to 12th century BC in the Carpathian Basin, it takes about three centuries for the peak to appear in Atlantic Europe. *Grosso modo* the mass of scrap hoards seems to indicate the final phase of the Bronze Age proper, with the term Bronze Age simultaneously signifying a very specific

form of metal-based economy and an equally particular phase of Old World history (Evans 1881). All this happens earlier in the southeast and later in the northwest of Europe (Huth/Logel 2023).

A similar gradient is observable with regard to the quantity of metal deposited in the ground. In the Carpathian Basin some hoards weigh up to and sometimes even more than 1,000 kg (Gușterița II [Sibiu County/RO]; Șpălnaca II and Uiora de Sus [both Alba County/RO]: Bratu 2009, 124), while in Britain the

Boughton Malherbe hoard (Maidstone district, Kent/GB) is the biggest accumulation of scrap metal and copper ingots of the Ewart Park phase (aka Ha B3 according to Central European terms) with as little as 64 kg (Adams 2017). Dünzlau (Ingolstadt/DE), dating to Bz D/Ha A, is by far the largest Late Bronze Age hoard from south Germany weighing a mere 38 kg (see Skolaut, this volume).

The discussion on what hoards (scrap hoards and all the many other forms of artefact deposition alike) may be standing for and why they have been buried in the first place and never recovered is still going on after more than 150 years of intensive research. Explanations range from purely economic terms (trade, recycling, money) to historical scenarios (crises, war, epidemics), to religious acts (gifts to the gods), and all sorts of cross-overs from the realms of imaginable human behavior (Huth 2024b). This is certainly not the place to review the actual state of debate. Suffice it to forward once more the unoriginal and banal argument that there are as many forms of hoards to be expected as there are occasions to deposit them, and therefore overall explanations are definitely not the way to solve the problem.

Although there are clearly identifiable patterns in the archaeological record of the Late Bronze Age scrap hoards, there is also a very specific kind of fragmentation and destruction of bronze artefacts mainly in Central and North-western Europe which is entirely different from the standard scrap described above. The objects in question have been burnt before deposition, something that can only very rarely be encountered in scrap hoards.

Like the scrap hoards the assemblages of burnt objects share a range of distinctive features. The selection of objects, the places where they have been deposited and the way they have been treated (apart from burning) are tell-tale evidence for a ritual context of fragmentation and destruction. However, depositions of burnt artefacts are by no means a uniform category of finds. A short *tour-d'horizon* will give a first impression of the characteristics and the particularities of a rather rare but typical Late Bronze Age phenomenon over large parts of temperate Europe.

A useful starting point is a collection of finds recovered in exceptionally good condition from the Silbersee near Roxheim (Bobenheim-Roxheim, Rhein-

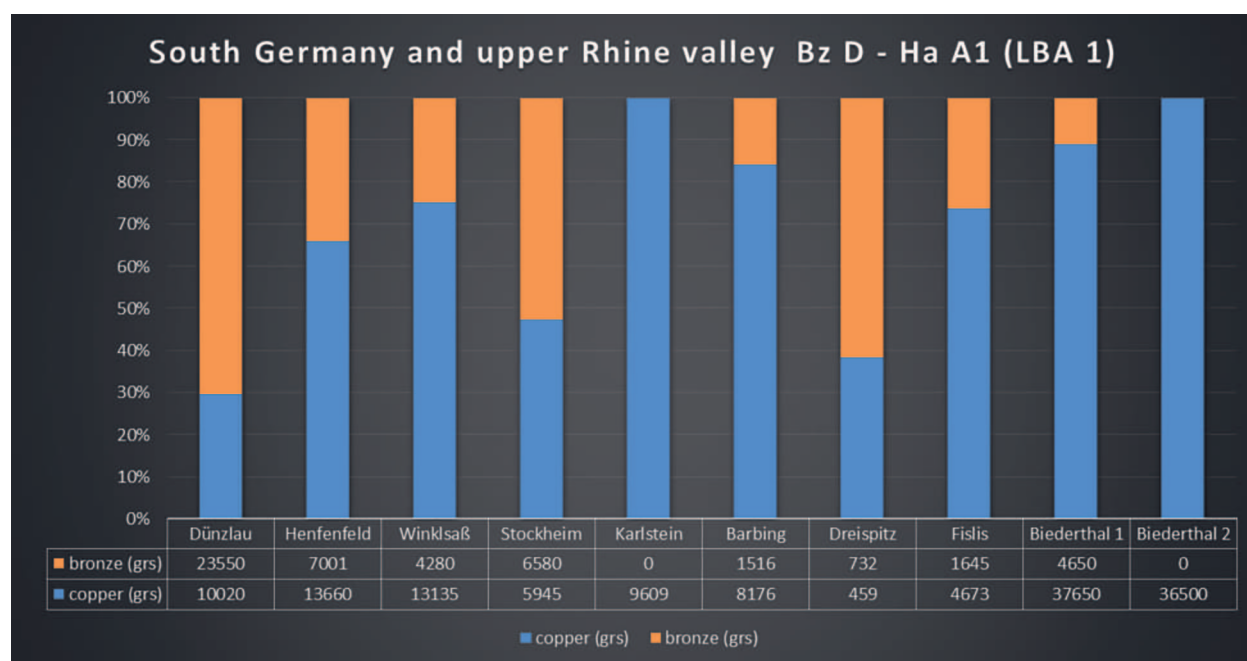


Fig. 2 Proportion of copper and bronze objects in scrap hoards from south Germany and the upper Rhine valley, Bz D–Ha A. – (After Huth/Logel 2023, 40 fig. 6).

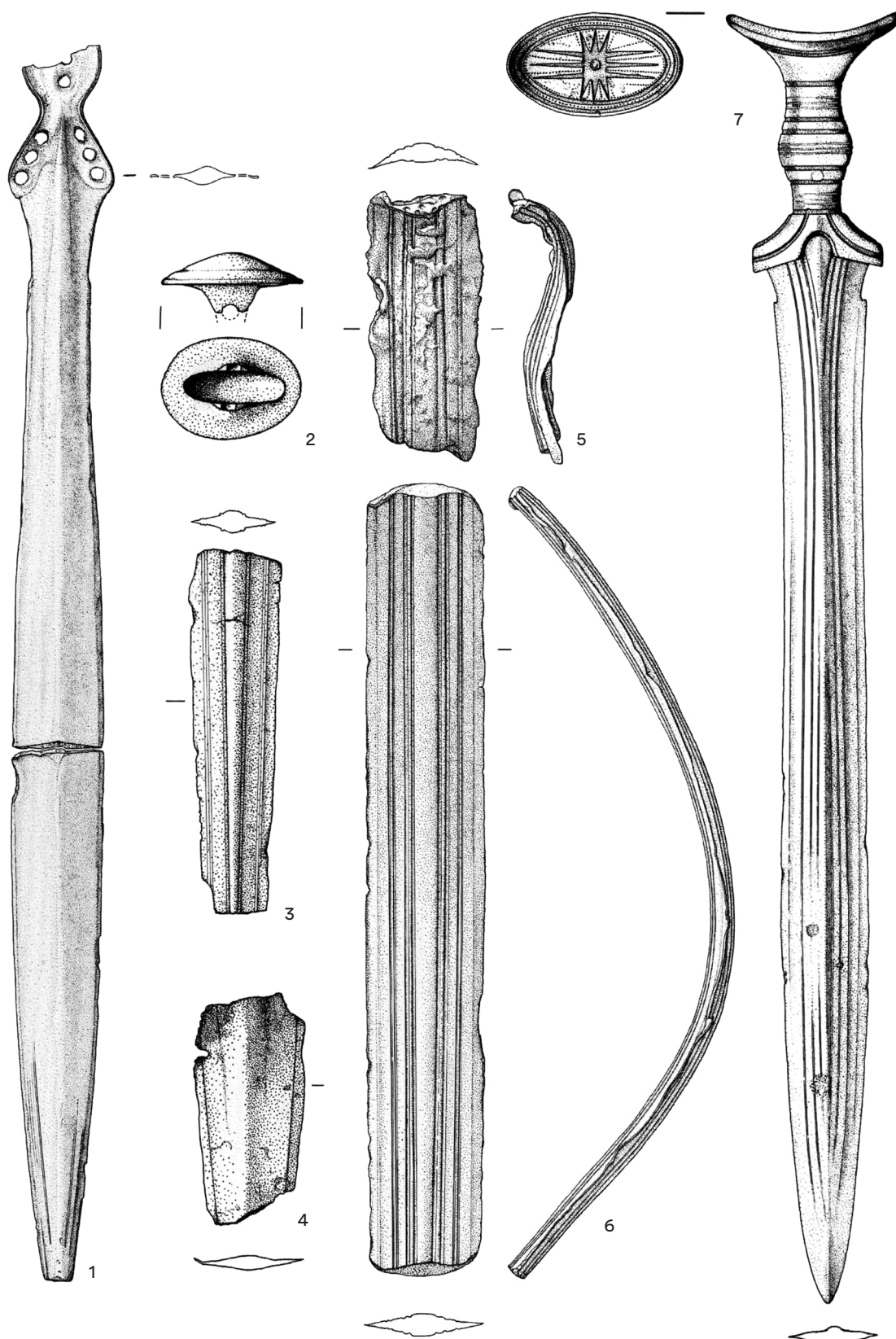


Fig. 3 Collection of finds from the Silbersee near Roxheim (Rhein-Pfalz-Kreis/DE). – (After Sperber 2006, 202 fig. 4). – Not to scale.

Pfalz-Kreis/DE), an oxbow lake of the River Rhine (Sperber 2006). It has been collected by amateur archaeologists screening the dredging of a gravel pit. The complex comprises 412 bronzes, mainly from the 12th to the 9th century BC. Most objects are weapons and ornaments, among them 100 pins, 49 ringlets, 25 bracelets, 33 spearheads, 27 swords, 18 axes and one fragment of a helmet. The large amount of small objects is remarkable for a river find, like awls, sewing needles and all sorts of accessories belonging to clothes and sword belts. Tools are represented by ten sickles, seven fish-hooks and other things. There are also wagon-fittings and horse-gear, and even a few leftovers from metalworking such as casting debris and ingots (**fig. 3; tab. 1**).

Many of the objects seem to have been willfully destroyed or damaged before being deposited, some of them also showing visible fire damage. The weapons are especially damaged, ornaments and other artefacts to a much lesser extent. Most of the smaller objects seem to be completely undamaged. Only at a first glance the corpus of finds resembles the scrap hoards known from the Late Bronze Age, especially those from France (cf. Huth 1997), and indeed many types originating in Western Europe can be found among the artefacts. But under closer examination

fundamental differences quickly become apparent, such as the fact that many fragments fit perfectly together which is rarely the case in hoards. Besides, it is highly unlikely that we are dealing with a closed find considering that the objects originate from a period spanning three centuries or more. The example of Roxheim illustrates that we also need to reckon with fairly different things among water finds if observational circumstances are good. It reminds us to be open-minded toward the unexpected.

It is indeed very uncommon to find fire damaged bronzes in hoards from dry ground. A rare exception is an assemblage of Late Bronze to Early Iron Age artefacts from Wattenheim (Lkr. Bad Dürkheim/DE) (Puhl 2019; Sprater 1939). There, a mass of mostly burnt objects has been discovered by road workers in 1937. Unfortunately, not much is known about the exact circumstances of the discovery. The objects have been placed over 1 m² in a depth of 60 cm. The deposit consists of 536 bronze objects weighing 7.24 kg, and 13 iron artefacts (**fig. 4**). Fragments of bronze sheet (1.82 kg) and molten lumps of bronze (2.45 kg) are the main components, together with seven socketed axes and four chisels or rather fragments thereof, eight sword fragments, a spearhead, four fragments of a handle of a vessel, three rings

Tab. 1 Objects dredged from the Silbersee near Roxheim (Rhein-Pfalz-Kreis/DE). – (After Sperber 2006, 207 fig. 9).

Category	Total number	Damaged/de- stroyed	Traces of fire	Intact
toiletries	2	2	1	
socketed hooks	2	2	2	
helmet	1	1	1	
swords	27	26	10	1
spearheads	33	27	15	6
sewing needles	3	2		1
bracelets	25	16	4	9
brooches	2	1		1
knives, dagger	9	4		5
pins	100	32	6	68
awls	35	7		28
arrowheads	13			13
fishhooks	7			7



Fig. 4 Late Bronze Age/Early Iron Age deposition from Wattenheim (Lkr. Bad Dürkheim/DE). – (After Sprater 1939, 159 fig. 1). – Not to scale.

and three sockets. The iron objects comprise fragments of two knives and a sickle, of a sword and a spearhead, three handle fragments of a vessel and three indeterminate objects. What looks like a scrap hoard at first sight turns out to be a singular find with no exact counterparts whatsoever. The large

mass of sheet metal is not found in scrap hoards of Central Europe, neither are iron artefacts commonly associated with bronze and copper objects, very few exceptions notwithstanding. Andreas Puhl (2019, 86–89) was able to identify a gradual procedure of fragmentation, mainly by fire, but equally by me-

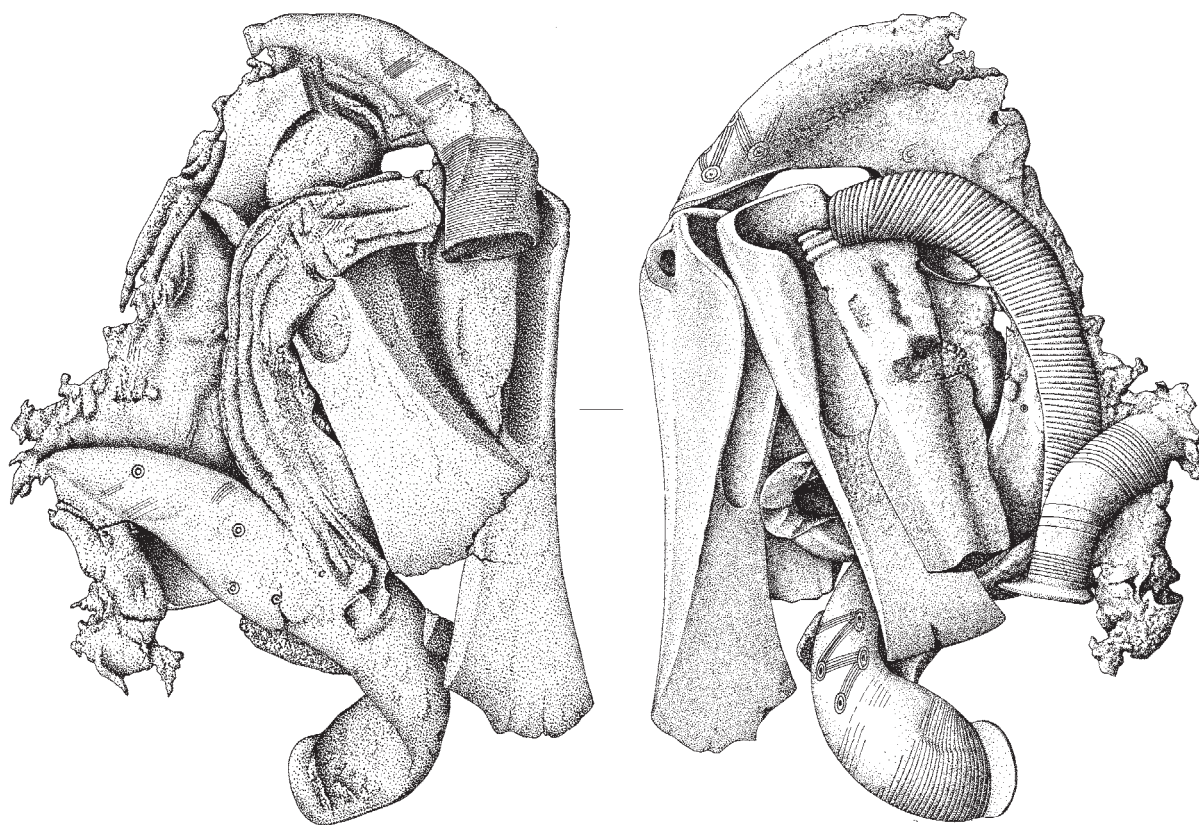


Fig. 5 A lump of molten bronzes from Lake Neuchâtel in Grandson-Corcelettes (Grandson, Ct. Vaud/CH). – (After Pászthory 1985, pl. 193). – Not to scale.

chanical destruction before and occasionally after burning. A very striking feature are the intense indentations on most of the blades which must have been applied before burning.

In contrast to this, lumps of molten and fused bronzes are well known from watery sites, particularly rivers such as the Thames and the Seine, but also from Swiss lakes (**fig. 5**). A large lump of molten bronzes has been dredged up from Lake Neuchâtel in Grandson-Corcelettes (Grandson, Ct. Vaud/CH) (Pászthory 1985, 198 nos 1420–1421; 215 nos 1676–1677). It is comprised of several bracelets, three palstaves, one spearhead, a sickle and some ornaments, weighing almost 2 kg. It has been rightly contended that these objects are not the relics of a cancelled production process. If the goal was to melt down older bronzes and reuse the metal for new items the bronzes would have been scrapped into much smaller pieces. On top of that, there are no crucibles in the size of this lump of metal. Relics of a process of remelting scrap are known from Bodrogkeresztúr (Borsod-Abaúj-Zemplén County/HU) (Mozsolics 1984, 52 no. 14 pls 5–6). They measure just up to 6 cm in di-

ameter. In contrast, the large lumps of partly fused bronzes show that specific actions preceded deposition, meaning that at least some of the many bronze artefacts in Swiss lakes were not simply thrown into the water.

There is a second lump of molten bronzes from Grandson-Corcelettes containing a palstave, a knife and a ring weighing 604 g altogether (Rychner 2001, 220 fig. 3, 4). Molten bronzes are known from other sites of the Swiss Three-Lakes and from the Lac de Bourget in France (Müller 1993; Rychner 2001; Fischer 2011). There are weapons such as swords, palstaves and spearheads, but also wagon parts and horse-gear and ornaments like bracelets. In Grandson-Corcelettes, Auvernier (Milvignes, Ct. Neuchâtel/CH) and Möriken (Ct. Bern/CH) 11 out of 31 swords show traces of fire. As it happens most of the bronzes were recovered in the 19th century, so there is hardly any information regarding the exact find context.

Several lumps of molten bronzes come from the River Seine in and around Paris at Corbeil, Morsang-sur-Seine, Essonne, the Pont Neuf and Villeneuve-

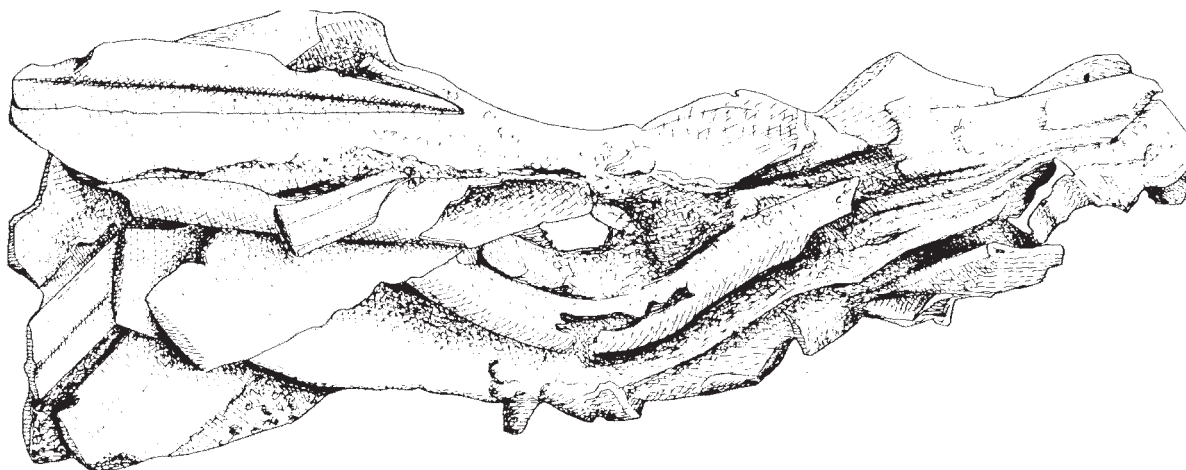


Fig. 6 A lump of molten bronzes from the River Seine near Paris/FR. – (After Mohen 1977, 131 figs 361–371). – Not to scale.

Saint-Georges (Mohen 1977, 118–119, 131–135; Mörtz 2024, cat. nos 2.10; 2.15; 2.19; 2.21; 2.25 pls 131–132, 151, 159–161, 168, 184–189). They consist of weapons only, although in some cases it is impossible to tell which objects are included in the lumps (**fig. 6**). The biggest one contains a socketed axe, fragments of four sword blades, fragments of three chapes, a spearhead and two ferrules.

Apart from conglomerations of metal objects there are also many single finds with traces of fire from the River Seine such as sword blades and spearheads (Mohen 1977). Ornaments, wagon and horse-gear like in the western Alpine lakes are missing.

Like the Seine the River Thames is rich in metal finds from the Bronze Age (Needham/Burgess 1980; York 2002). These were recovered by river dredgers and acquired by museums and private collectors from the 19th century onwards. There are large collections in the British Museum, the Museum of London, Reading Museum and other institutions. Weapons are a prominent feature among river finds from the Thames, particularly so swords and spearheads. Of these about 50–60 % are damaged or broken, while some show also traces of fire. There is a lump of molten spearheads from London found along with a few more items which are not fused together reputedly dredged at »Thames Street« (**fig. 7**) (Burgess et al. 1972, 239, 266 fig. 24, 1–7; Mörtz 2024, cat. no. 2.24 pl. 183). There are also some burnt single finds from the Thames. Exact findspots are rare and information on contexts are virtually non-existent.

Finds from wet contexts are very frequent in the fenlands of East Anglia. Again many finds are from

the 19th century and lack any further documentation. For a while it was not exactly clear if all these objects were deposited right in the fens or on dry ground on the edge of the fens. Today, excavations in Flag Fen, Must Farm (Cambridgeshire/GB) and other places have strongly enhanced our knowledge of Fenland archaeology (Pendleton 1999; Pryor 2005; Ballentyne et al. 2024; Knight et al. 2024). This is also the case with Bradley Fen, located in the brick pits of Whittlesey (Fenland district, Cambridgeshire/GB), right next to Must Farm and Flag Fen (Knight/Brudenell 2020, 180–219; Mörtz 2024, cat. no. 2.5 pls 96–101). Late Bronze Age metalwork, including single spears and a weapon hoard, was deposited along a particular stretch of the gradually submerging margins of an earlier field system. The hoard comprised three broken swords (surviving as hilts and shoulders), three sword blade fragments, three pieces of a long tongue chape, nine complete or semi-complete spears and two ferrules. The bulk of the hoard objects displayed extensive damage and, as well as being broken-up, the pieces were also bent, severely notched, perforated, dented and burnt. At least five of the hoard pieces (three spears, a sword and a ferrule) had been exposed to fire prior to deposition. There was no evidence of *in situ* burning. Taken as a whole, the impression was that the hoard contained weapons that each had an extended use-life prior to deposition. The breaking-up and burning of some of the pieces indicated purposeful acts of destruction unlike anything seen on metalwork elsewhere in the Flag Fen Basin. A few meters away six spearheads were found. The spears occurred in three groups, two as isolated

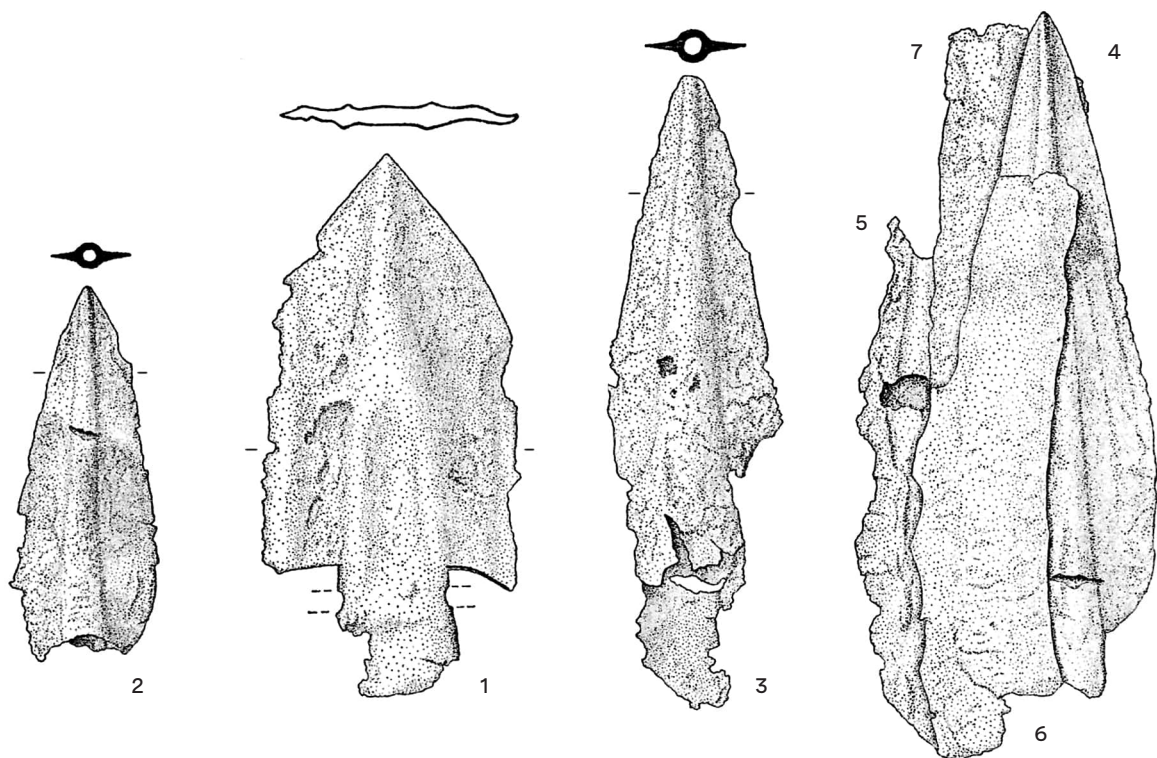


Fig. 7 A lump of molten spearheads from the River Thames at »Thames Street«, London/GB. – (After Burgess et al. 1972, 266 fig. 24, 1–7). – Not to scale.

pieces, and four as a rough line. In contrast with the hoard pieces, only one spearhead was damaged. The poor state of this object appeared to be post-depositional.

A close correlation with water has also been demonstrated at Broadward in Shropshire (West Midlands/GB), a famous find unearthed in 1867 while draining a marshy field (Burgess et al. 1972). Later investigations suggest that the findspot was situated close to a spring. The Broadward hoard is almost certainly not complete, as it is generally the case with discoveries from earlier times. Today it comprises eight sword fragments, 23 spearheads and another 15 of the barbed type, four or five ferrules, a chisel, two bugle-shaped objects and a ring. While the publication of Colin Burgess, David Coombs and Gareth Davies states that the objects are badly corroded and broken, it is impossible to tell which artefacts are burnt from the drawings alone. Tobias Mörtz recently published a very useful and diligently revised catalogue of Late Bronze Age weapon depositions in North-western Europe (Mörtz 2024). The catalogue features drawings and color photos alike, and therefore it is now much easier to assess if artefacts have been damaged by fire, which is indeed

quite often the case (Broadward: Mörtz 2024, cat. no. 2.8 pls 121–128). However, sometimes a correct diagnosis remains a difficult task. Therefore, it would be helpful to indicate in general in the text if objects have been burnt. As a matter of fact, observations of this kind are frequently overlooked, and this means that any thorough investigation into the subject can only be carried out by autopsy in the museums.

A find very similar to Broadward was ploughed out from a former bog, which was being drained, in Peelhill Farm (Lanarkshire/GB) in 1961 (Mörtz et al. 2021; Mörtz 2024, cat. no. 2.20 pls 162–167). The hoard consists of 46 spearheads, three ferrules, three swords, three rings and an axehead (**fig. 8**). Nearly all the weapons are bent and broken, and many reveal traces of burning. Several pieces show signs of extensive treatment with fire, causing severe deformation, including bubbling, melting and warping, giving evidence that many were broken while hot. The sword has not been treated with fire. Only the lower breakage is old and a result of excessive bending. Notches in the blade suggest the sword had been employed in combat before deposition.

The northernmost deposition of burnt bronzes is Duddingston Loch (Edinburgh/GB) (Mörtz 2024,

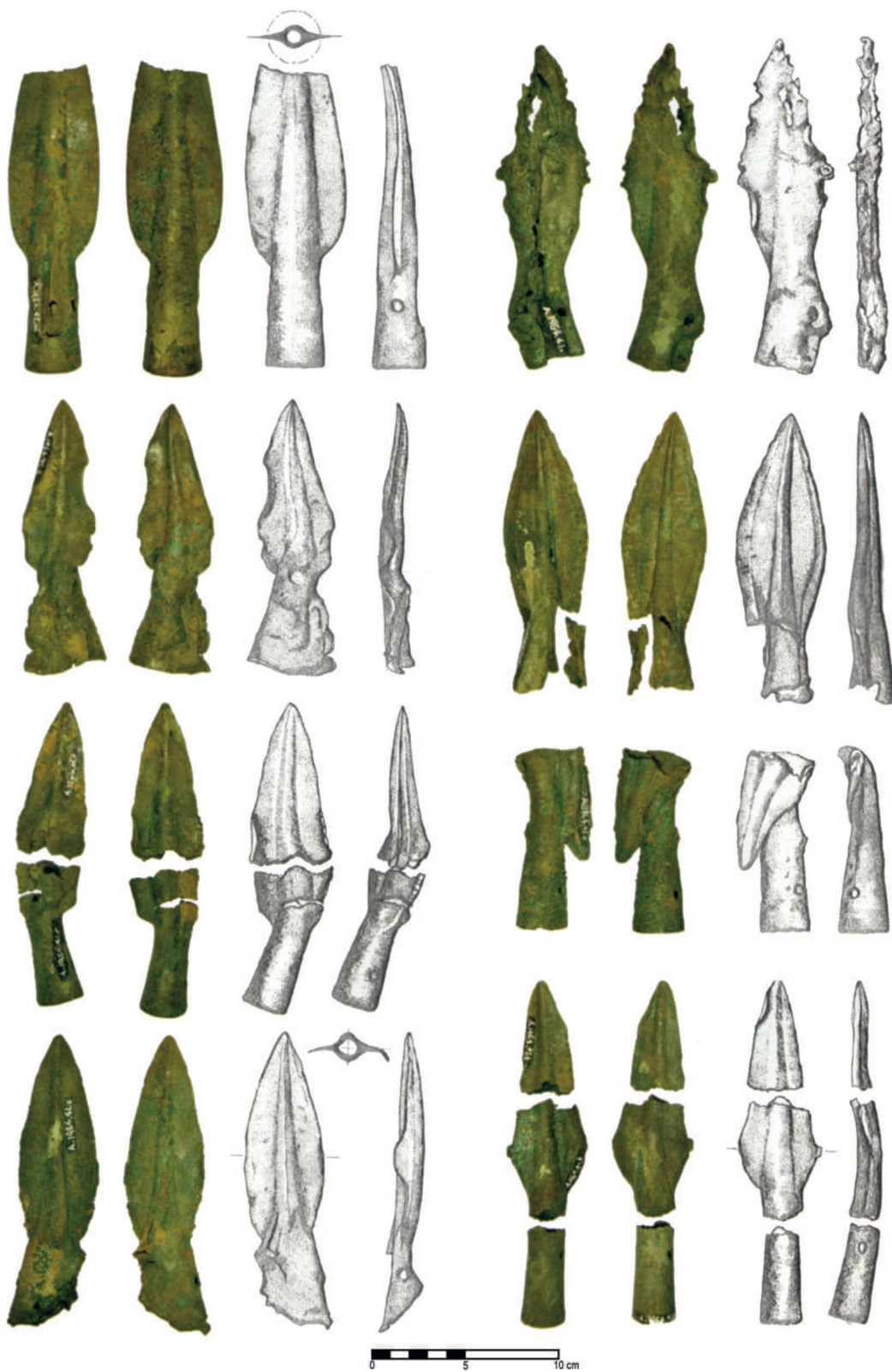


Fig. 8 Spearheads from Peelhill Farm (Lanarkshire/GB). – (After Mörtz et al. 2021, fig. 14).

cat. no. 2.11 pls 134–142). The lake lies at the foot of a hill called Arthur's Seat. In 1778 dredgermen brought to light a large quantity of metalwork, comprising swords, spearheads and the ring-handle of a bronze bucket (**fig. 9**). The exact size of the deposition remains unknown. The find was originally dispersed between King George III, Sir Alexander Dick, who owned the loch, Sir Walter Scott, and the Museum of the Society of Antiquaries of Scotland. More swords and one further spearhead were acquired by the museum of the Society of Antiquaries in 1935. Many of the objects were partly fused together. Traces of an intensive treating by fire can be detected on many of the remaining pieces. The bronzes had all been deliberately damaged by bending, breaking and burning. It seems very likely that the metalwork has been deposited on a single occasion and not successively like in Roxheim. One of the spearheads is of the barbed type typical for depositions of the Broadward series (Burgess et al. 1972; Mörtz 2024, pl. 142, DQ42).

In addition to these finds there are several weapon deposits containing just one or a couple of artefacts with traces of fire. To these belong hoards from Bramber (Horsham district, West Sussex/GB), Broadness (Kent/GB) and Wilburton (Cambridgeshire/GB), Ashley Wood and possibly Andover and Blackmoor (Hampshire/GB), most of which come from a watery context (Mörtz 2024, cat. nos 2.2; 2.4; 2.6–2.7; 2.27). An example for a deposition on dry ground would be the Waterden weapon hoard (Norfolk/GB), which comprises 190 objects, mainly fragments of swords and spearheads, with just four sword fragments and four spearheads showing traces of fire (Mörtz 2024, cat. no. 2.26; Bridgford/Northover 2020). Traces of wear and the good quality of the objects demonstrate that the weapons had been in use before destruction. »Depending on where the weapons were placed in the fire they would be exposed to a range of temperatures and reducing or oxidising conditions. The result would be microstructural changes ranging from enlarged grain sizes with no surface alteration to distorted fragments with internal oxidation and blistered surfaces, indicating temperatures from 500°C and a reducing atmosphere to temperatures in excess of 800°C. To achieve the latter conditions would almost certainly require the construction of a



Fig. 9 Deposition of burnt bronzes from Duddingston Loch (Edinburgh/GB). National Museums Scotland. – (CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=107680773>). – Not to scale.

pyre or a large bonfire and a good breeze: if the fire were smaller then bellows could be needed« (Bridgford/Northover 2020, 78). This also means that treatment with fire cannot always be determined by eye. On the other hand, where traces of burning are visible they must result from quite a large fire. Fire treatment is a common method to produce scrap for remelting as has been demonstrated by M. Knight (2019; 2022, 22–26). As Sue D. Bridgford and J. Peter Northover (2020, 79) point out, »one aspect [...] is that different products and different materials will fragment in different ways, an obvious example being that the process of breaking up a copper ingot differs markedly from that of breaking up a leaded bronze spearhead, both because of the different forms and because of the differing mechanical properties at both low and high temperatures«. Taking these technological aspects into account, it is not

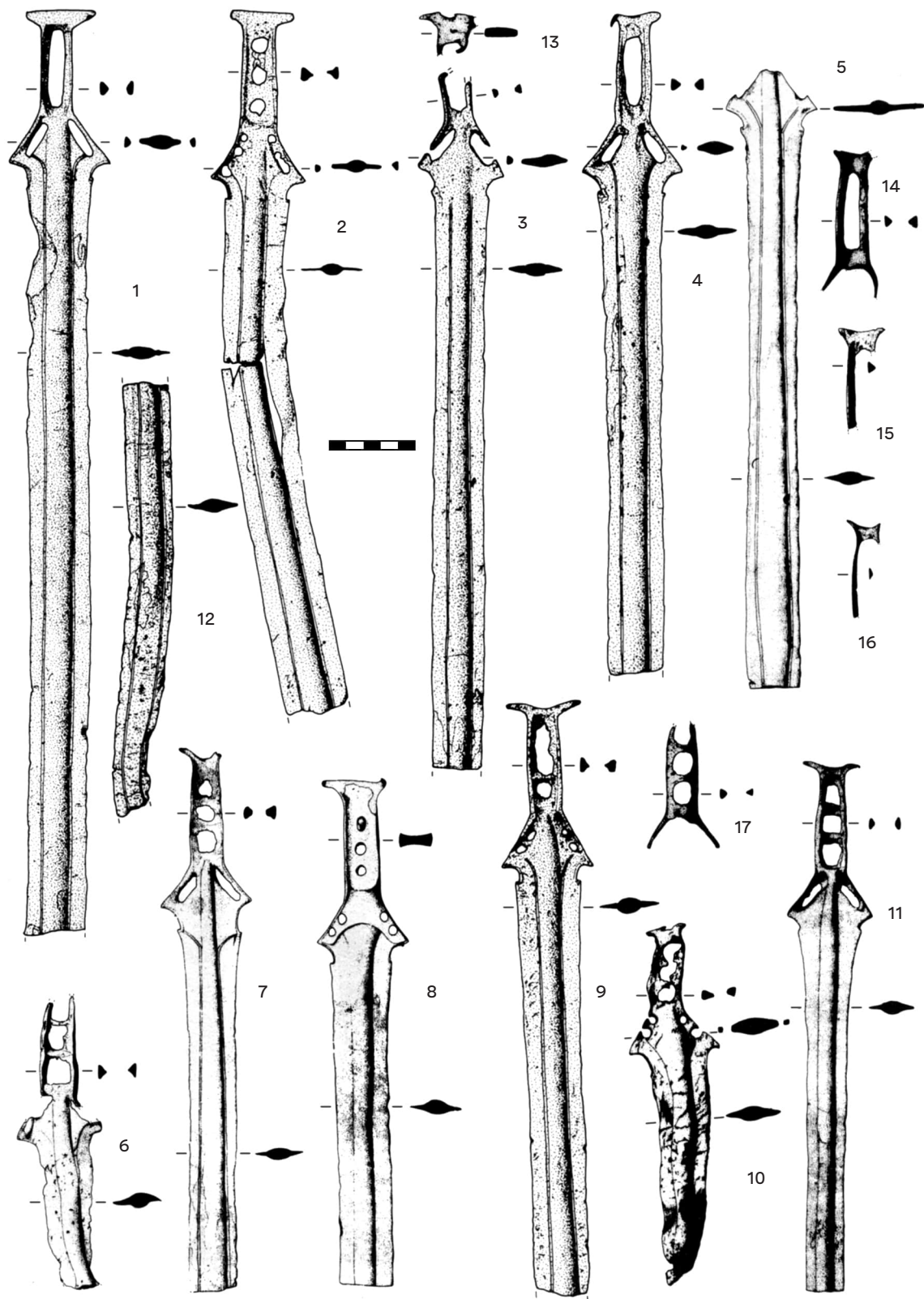


Fig. 10 Swords from ría de Huelva (prov. Andalusia/ES). – (After Ruiz-Gálvez Priego 1995, 237 pl. 7). – Not to scale.

surprising to see that the patterns of fragmentation in weapon hoards are strikingly different from those found in scrap hoards. Pieces are much larger and generally fit together, often allowing the reconstruction of entire objects, mainly swords and spearheads. This is basically never the case in scrap hoards, where at most miscasts may be pieced together to whole swords like in the hoard from Challans (dép. Vendée/FR) (Verney 1990). Considering the selection of objects (basically weapons only, sometimes to a small extent also wagon or horse-gear), a strong (although not exclusive) inclination to watery contexts and the destruction under somewhat showy circumstances (bonfires, pyres), there can be no doubt that hoards of weapons (entire or fragmented, with and without fire treatment) and hoards of scrap are two entirely different affairs (Huth 2016). Late Bronze Age weapon depositions of North-western Europe have been thoroughly investigated by Mörtz (2024). While the focus of Mörtz' study is on weapons, it is the destruction by fire which is the topic of the present article.

It is therefore necessary to widen the horizon beyond Central and North-western Europe and to take a look at a couple of finds further away. The first complex was dredged from the ría de Huelva (prov. Andalusia/ES) a hundred years ago (Ruiz-Gálvez Priego 1995; Brandherm 2007; Fernández Rodríguez 2014). It consists of approximately 400 objects, among them 83 swords, 24 daggers, 87 spearheads, 59 ferules, 14 arrowheads, four helmets and 57 rivets (**fig. 10**). There are also some ornaments, such as eight brooches, two pins, three neck rings and two rings. Originally interpreted as the sunken cargo of a boat it is now generally considered to reflect repeated ritual offerings over the time, sometimes in the context of burials. At least some of the objects clearly show traces of fire. However, the catalogue of the publication by Marisa Ruiz-Gálvez is not specific about their state of preservation. It is impossible to tell from the illustrations alone if an object has been damaged by fire or not. It is basically very much the same situation as with the so many other finds.

In northern Italy the hoard from Pila del Brancon (Nogara, prov. Verona/IT) is a chance discovery made in 1993 at the bank of the River Tartaro (Sestieri et al.

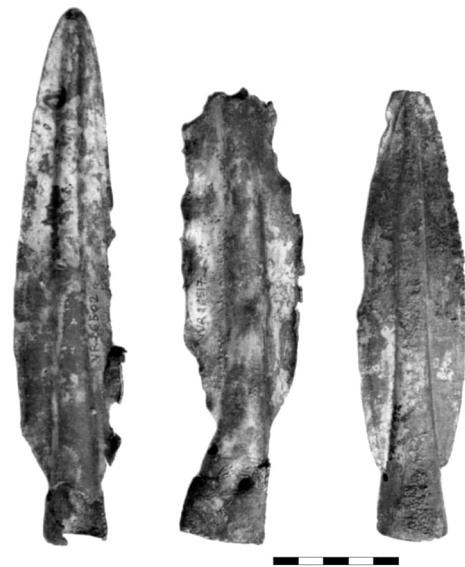


Fig. 11 Spearheads from the hoard of Pila del Brancon (prov. Verona/IT). – (After Bietti Sestieri et al. 2013, 161 fig. 5). – Not to scale.

2012; Bietti Sestieri et al. 2013). It consists of 10–13 swords of which eight are more or less complete, two daggers and about 50 spearheads, plus some fragments of defensive armor, such as a helmet, possibly a cuirass and greaves, and finally parts of a bronze vessel (**fig. 11**). Subsequent excavations indicate that the objects were originally deposited in the water, simultaneously. Many of the objects show traces of fire and were fused together, although there are some pieces which were still intact at the time of deposition. Much effort has been spent on the treatment of the swords. The hilt was often broken and the organic handle removed by the use of fire. The terminal section of the blade was heavily hammered and also sometimes treated with fire. Some of the swords were finally bent into a U-shape, others were cut into two or more pieces. The treatment of the spearheads was less systematic. Damaging included hammering the whole object, crushing the sockets or removing parts of the blades. The pieces which had been mechanically damaged and the resulting fragments were exposed to fire, sometimes melted and fused individually or by groups. The defensive armour was cut into pieces, the fragments bent and hammered together, partly melted and fused together.

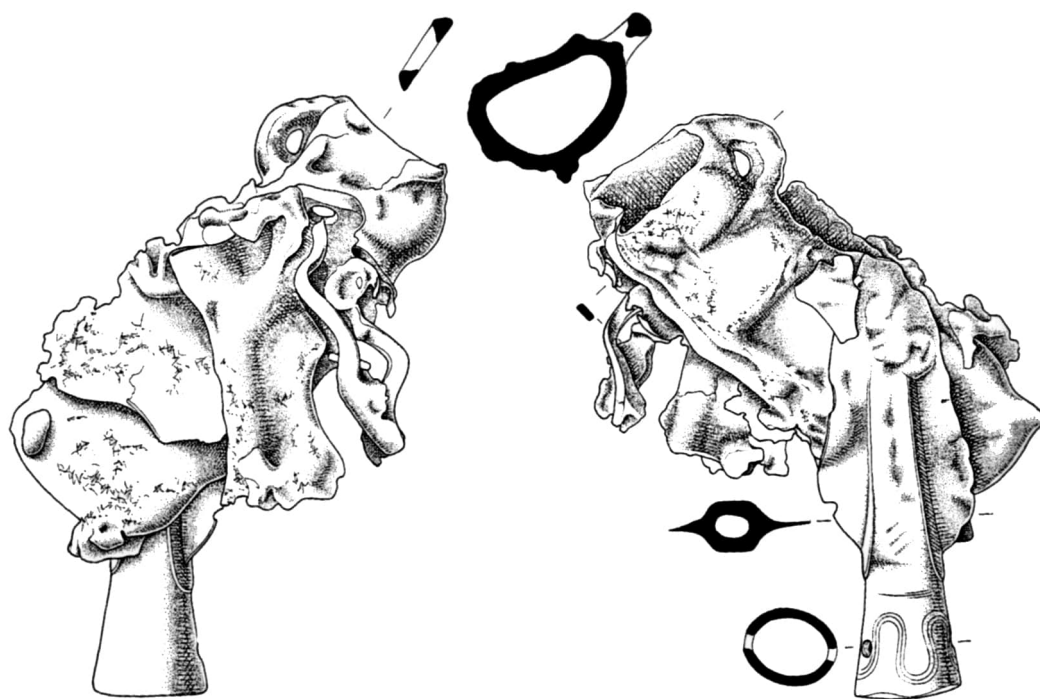


Fig. 12 A lump of molten bronzes from Mušja jama Cave near Škocjan (Divača/SI). – (After Teržan et al. 2016, 686 pl. 11, 1). – Not to scale.

Finally, large quantities of molten bronzes come from the Mušja jama Cave near Škocjan (Divača/SI) (Teržan et al. 2016). The cave reaching 50 m vertically into the ground was the place of repeated depositions from the 12th to the 8th century BC, altogether more than 800 objects. Weapons dominate among the deposited objects, with 240 spearheads, but also socketed axes, swords, helmets and bronze vessels. Tools, ornaments and horse-gear are present, however in very little quantities. Most bronzes are broken, not necessarily by throwing them into the cave, but by willful destruction before deposition. This is undoubtedly the case for those objects with traces of fire. A molten lump with an axe, a spearhead, a chisel and parts of a bronze bowl altogether weighing 861 g is very reminiscent of all the molten lumps of bronze reviewed so far (**fig. 12**). Although the Mušja jama Cave has been repeatedly compared with scrap hoards (interestingly enough in order to demonstrate that scrap hoards may have nothing to do with metal recycling; cf. Mörtz 2024, 269–270), the find has not much in common with this category of deposition. The selection of the objects (mainly weapons and bronze vessels), the treatment by fire and the place of deposition do not relate at all to average scrap hoards. If anything, the Mušja jama Cave assemblage there is a vague resemblance with the Wattenheim deposition as already pointed out by Friedrich Sprater (1939, 162) a long time ago.

To sum up, the finds with burnt bronzes are entirely different from scrap hoards which are so typical of the Late Bronze Age. This goes for their composition, i. e. mainly weapons and particularly swords and spearheads, the strong correlation with water, i. e. rivers, bogs and lakes, and the method of damaging or destroying the artefacts, i. e. by fire. There are single objects and larger collections reflecting continuing depositions over the centuries alike. The fire treated objects and the fused lumps of bronze show that specific actions preceded the deposition, meaning that at least some objects found in rivers, bogs and lakes were not just simply thrown into the water. Therefore, one might ask which action was possibly more important – the act of destruction by fire or the final deposition in the ground, be it dry or wet or an abyss like in the Slovenian karst?

Quite obviously all these finds have common roots in ritual behavior and religious thinking of the Late Bronze Age, notwithstanding their dispersed and patchy distribution over several centuries and large parts of Europe and as a consequence their relative rarity. Yet as it stands it would be not advisable to look for an overall explanation of the phenomenon. With regard to Late Bronze Age weapon depositions in the British Isles there have been some in-depth discussions in recent years (Bridgford/Norther 2020; Knight 2022; Knight/Brudenell 2020; Mörtz 2024; Mörtz et al. 2021), as has been the case

with Urnfield weaponry on a European scale (*inter alia* Mödler 2017; Uckelmann 2012).

Bearing in mind that archaeology means looking for patterns it might be more rewarding to look at finds which display some intersection with the fire treated objects discussed so far. In the first place there are all these depositions of more or less intact weapons in waters, like some hoards of the Broadward complex and of course single finds as well (Burgess et al. 1972; Huth 2016). Then there are weapon hoards from dry ground like in Stoke Ferry (Norfolk/GB), with broken but otherwise complete objects (Hawkes 1955). Weapon hoards from dry ground are a fairly common feature of the Wilburton phase in England (Coombs 1975; Mörtz 2024), but not on the continent, while depositions of intact swords in pairs or triples are especially known from northern England and Scotland in the Ewart Park phase (Colquhoun/Burgess 1988; Mörtz 2024, 379).

The deposition of fire treated weapons is a typical feature of La Tène sanctuaries like Gournay-sur-Arondé (départ. Oise/FR) (Brunaux et al. 1985; Brunaux/Rapin 1988; Lejars 1994; Goudineau 2006). The folding of swords, which can also be observed among watery locations like La Tène (Ct. Neuchâtel/CH) itself, requires heating to make the iron soft and malleable (Honegger et al. 2009). Other traces of destruction like the excessive indentation of sword blades

and the perforation of shield bosses can be traced back to hoards and river finds of the Late Bronze Age (Melksham, Wiltshire: Huth 1997, pls 39–40; Mörtz 2024, 238–239). They demonstrate significant strands of continuity with regard to ritual and religion over the centuries.

And last but not least the burning of bronzes on the pyre is a common funerary practice of the Late Bronze Age (Mordant/Depierre 2005; Stig Sørensen/Rebay-Salisbury 2023), and it is also a characteristic feature of many burnt offering sites (*Brandopferplätze*) in the Alps (Steiner 2010). However, it should be kept in mind that there is hardly any intersection between Urnfield grave goods and the composition of the fire treated depositions in rivers, lakes and bogs (which is in fact sometimes taken as an indicator for a mutual relationship between river finds and burials: Sperber 2006).

There can be no reasonable doubt that all these finds belong to the religious sphere in a wider sense. It is therefore quite striking (although maybe not surprising) that they have virtually nothing in common with scrap hoards. Fragmenting objects was a distinctive practice in the context of ritual and religion, as it was a common practice in metallurgical activities. Consequently, fragmentation does not mean fragmentation, as can be inferred from different patterns of destruction.

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Fragmentation and Metrology

Breaking Metals

Quantification and Interpretation of Bronze Fragmentation in Bronze Age Italy and Europe

ABSTRACT

This article explores the phenomenon of bronze fragmentation in Bronze Age Italy and Europe, focusing on the quantification and interpretation of metal breakage practices. The intentional fragmentation of bronze objects from the Middle Bronze Age onwards has been interpreted through ritual, utilitarian, and economic lenses. This paper reviews existing classifications of fragmentation methods and their interpretive implications, proposing an alternative proxy to assess the purpose of fragmentation: weight analysis as a null hypothesis. By applying quantitative methods, such as metrological analysis and statistical evaluation, this study offers a comprehensive understanding of fragmentation processes and their socio-economic implications. Drawing on data from hoards across Europe, the article argues that bronze fragments, often shaped to specific weight standards, may have functioned as money, aligning with the development of weighing technologies.

KEYWORDS

Bronze Age hoards | fragmentation | scrap hoards | Bronze Age money | economics

Hoarding and Fragmentation Studies: A Brief Overview

The practice of depositing metal objects, particularly copper-alloyed, emerged prominently in Europe during the late 3rd millennium BCE and continued into the 2nd millennium BCE (Peroni 1994; Bradley 2013). The hoards contain objects intentionally buried together, and their interpretation has been the subject of extensive debate, with scholars' views primarily divided between ritual and utilitarian explanations (Bradley 1990; 2005). The phenomenon of hoarding is made even more enigmatic by the appearance, around the middle of the 2nd millennium BCE, of the practice of fragmenting deposited objects (Brandherm 2018; Hansen 2016; Huth 1997; Nebelsick 2000).

The systematic study of metal fragmentation across Europe reveals regional variations and temporal shifts. For instance, in Central and Southern

Europe, fragmentation practices became widespread during the Middle/Late Bronze Age (Hansen 2016; Lago 2020). Starting from the mid-2nd millennium BCE, single-class hoards became increasingly rare (Neumann 2015; Lago 2020), making it harder to find coherence in the mixture of different objects collected together (Wiseman 2018). Only rarely does this operation appear convincing, while in larger hoards, there often seems to be a heterogeneous collection of objects with varying degrees of fragmentation. The increased fragmentation and changing patterns of hoard compositions – moving from complete objects to fragments and from single-class to multi-class hoards (Neumann 2015) – may suggest shifts in metal circulation, possibly tied to evolving trade practices (Primas 1997), changes in ritual practices (Brück 2006), increasing consumption of met-

al with related metal recycling (Wiseman 2018) and several other possible explanations.

While trying not to oversimplify such a complex topic, we can attempt to group the various interpretations given over almost 150 years of study into three main hypotheses to explain the phenomenon of fragmentation and, in some way, the phenomenon of hoarding itself.

The Ritual Hypothesis: This theory suggests that the intentional fragmentation of objects was part of a ritual to erase their functional value and transform them into offerings for deities. The manipulation of bronze items – such as bending, twisting, or burning – could be seen as an act of »killing« the object. This approach posits that the objects' destruction was a symbolic gesture, marking a transition or serving as a sacrifice, and thus, objects were not meant to be retrieved once deposited.

The Recycling Hypothesis: This perspective views the hoards as temporary metal stores intended for recycling by metalworkers. Broken objects or

metal scraps found in hoards could indicate these were »founders' hoards« – collections meant for future melting and reuse. This theory also contemplates the practical aspects of transporting and recycling bronze, suggesting that objects might have been fragmented to fit transportation needs or to prepare them for melting processes.

The Money Hypothesis: Some scholars propose that fragmented metal objects served as a form of currency. According to this view, objects were broken down into pieces of specific weights to facilitate trade, reflecting a widely accepted economic value.

Some authors – and I agree with this contention – believe that these explanations are not mutually exclusive (Bradley 2005; Brandherm 2018). Hoards could simultaneously serve ritualistic, utilitarian, and economic purposes. For example, bronze fragments might circulate as money but could also be deposited in a ritual context or melted down to produce new objects, indicating that the functional and symbolic uses of metal were often embedded.

Breaking, Fragmenting, Damaging, Portioning: Towards a Shared Methodology to Classify Fragments

In recent years, interest in the study of fragmentation practices has intensified, as evidenced by the conference held in Mainz in 2023. The increase in studies has inevitably led to the need to more clearly define what is meant by fragmentation, breaking, damaging and all other terms that were more or less used interchangeably in the literature of the last century.

There are several proposed classifications of fragments. Among the most influential studies on the subject are probably those by Ch. Sommerfeld (1994), B. Rezi (2011), and M. G. Knight (2021). All these authors agree that it is important to distinguish between deliberate fragmentation and non-deliberate fragmentation, where non-deliberate fragmentation refers to that caused by the use of the objects.

The criteria used to establish this, however, are slightly different and require varying levels of observation. According to the classification by Sommerfeld (1994, 32), one must distinguish between unintentional fragmentation due to the use of objects (*funktioneller Bruch*); ritual fragmentation, which includes items shattered, destroyed, broken, and with traces of prolonged exposure to fire (*ideeller Bruch*), where the objects are partially or completely reconstructible, with the aim of preventing the profanation of metals once deposited; and material fragmentation, which includes items broken, cut with chisels, bent, or shattered (*materieller Bruch*), where the objects are no longer reconstructible and the goal is to reach specific weight standards.

The classification by Rezi (2011) is more focused on the intensity of fragmentation, which to some ex-

tent would also explain the function of the fragmentation itself. The lowest intensity of fragmentation is found in damaged objects. These are not necessarily broken but have been subject to twists or blows that cannot be explained by normal use and are therefore intentional. The categories of broken and destroyed objects are distinguished by the intensity of fragmentation. While some broken objects could result from the object's use, destroyed objects have always been intentionally fragmented. The latter, in fact, are often broken into multiple pieces and do not allow for the reconstruction of the original object.

The most recent classification proposal is the one suggested by Knight in various articles (e.g. Knight 2021 and this volume). The author has created a well-structured classification grid for fragments (Damage Ranking System) that, through observation of the fragments, allows for categorizing them into one of the proposed categories and hypothesizing the nature of the fragmentation. It is a very detailed grid, and therefore, reference is made to the original articles. In an attempt to simplify, I propose a summary of what the author suggests: bending, twisting, notching, and breaking can always result from either voluntary or involuntary actions. To determine the intentionality or randomness of these events, careful observation of the objects is required. Break-

age due to use can be suggested by wear traces and the characteristics of the break itself (e. g. at points of structural weakness, production flaws, bending not associated with other signs of damage); definite intentional breakage is indicated when extreme bending is associated with damage, notches inconsistent with the object's use, or twisting on objects not usually subjected to such treatment. Between these categories, there is a broad overlap that includes objects likely broken intentionally, where the intensity of twisting and bending, as well as the depth of notches, suggests deliberate actions.

Although these are different classifications, the intensity of fragmentation seems to be a common and important parameter for determining the intentionality of the action, and the shared idea is that deliberate fragmentation can serve both ritual and utilitarian purposes. While the proposed classifications may be quite accurate in determining the intentionality of fragmentation, it must be said that they provide little insight into the purpose of the fragmentation itself. Therefore, while we can consider that the search for proxies to indicate intentionality or non-intentionality has reached a good degree of reliability, the same cannot be said for the search for proxies that indicate whether the fragmentation was ritual or utilitarian.

Breaking Marks are Unreliable Proxies for Determining the Purpose of Fragmentation

The information derived from the types of fragmentation is, in my opinion, sometimes biased. In my presentation at the conference held in Mainz in November 2023, I did not include slides on the experimental archaeology of bronze fragmentation. However, during the interesting discussion slots, the importance of insights gained from metal fragmentation experiments was repeatedly emphasized. For this reason, before resuming the discussion on fragment classification, I shall briefly touch on some observations I made while fragmenting the objects.

In June 2021, I carried out an archaeological experiment with some colleagues that included:

- The experimental production of 20 bronze sickles.
- The production of equal-arm balances and balance weights consistent with those attested in the Bronze Age.
- The breaking of the sickles using chisels, axes, and hammers after heating them in a fire, with the goal of obtaining fragments of the same weight as the balance weights.
- Weighing on equal-arm balances while noting the perception of weight equality/inequality.

The results of the experiment and the data have been published, and reference is made to the orig-

inal article (Lago et al. 2023). However, many other unexpected results emerged. My colleagues and I found that – just as correctly highlighted in other studies (Knight 2017; 2019) – breaking bronze without properly heating it first is very difficult, even for thin objects like sickles. Handling red-hot objects and striking them with the intent of breaking them can generate a number of other unexpected fragments caused by the impact. Additionally, it often happened that we damaged the object without successfully breaking it on the first attempt. The marks from these failed breaks remained clearly visible once the bronze had cooled. Even though we assume that the skill and experience in handling metal that people in the Bronze Age had is incomparable to that of myself and my colleagues, it is impossible not to notice a certain similarity between the results of our mistakes and some of the archaeological artefacts found in hoards (e.g. Stein 1979; Sommerfeld 1994; Gabillot 2000; Toune 2014; Nowak et al. 2019).

In particular, during the attempt to break some sickles that were not sufficiently heated, the blows caused the object to bend but not to break (**fig. 1**). In other cases, the attempt at fragmentation resulted in notching of the object, leaving clearly visible blow marks (**fig. 2**). Some of these marks are attested in Bronze Age objects from hoards and are often interpreted as evidence of ritual activity, with the argument that, having no apparent practical function, this type of fragmentation or damage can only be ritual (Nebelsick 2000; Gabillot/Lagarde 2008; Rezi 2011; Bietti Sestieri et al. 2013; Dietrich 2014; Tarbay 2022).

While not denying that they can also actually result from fragmentation occurring in a ritual con-

text, I would like to point out that such outcomes can also be accidentally achieved. Consequently, the observation of similar traces on objects cannot be considered definitive proof, but rather circumstantial evidence.

Since the treatment of objects is not a reliable proxy for distinguishing between utilitarian and ritual fragmentation, researchers mainly rely on qualitative observations such as:

- The context of the deposition (when available).
- The type of objects contained in the hoard.
- The observation of specific traces on the objects that are believed to indicate the reason for the fragmentation (e.g. supposed ritual traces such as fire marks presumably linked to ritual activities; extreme degree of twisting and fragmentation; blocked socketed axes, etc.).

This inevitably leads to speculative and sometimes contradictory arguments. For example, while one might assume the »cultic« nature of certain sites (mountain peaks, river courses, sanctuaries), it is rather difficult to establish the »non-cultic« nature of all other locations. Indeed, many reasons – beyond our understanding – could have contributed to making a place »sacred« in the past, just as they do today. Likewise, a scrap hoard from a settlement should not necessarily be considered a foundry stock (Bernabò Brea/Cavalier 1980; Borgna 2021). Additionally, a large part of the hoard dataset unfortunately comes from old and unsystematic excavations, or even from the antiquities market or museum collections, making it impossible to obtain reliable information on the find contexts.

From Qualitative to Quantitative Analyses: In Search of New Proxies

The proposed classifications for fragmentation are useful for the autoptic study of materials and can certainly provide valuable insights in a context-by-context approach. However, to study fragmentation using the vast bibliography of already

published hoards, it is necessary to use an even simpler classification, applicable to all or a significant portion of the published material.

In order to quantify fragmentation across various periods and regions of Europe, we limited our

Fig. 1 Experimental bronze sickle replica made as part of an archaeological experiment. – **A** Sickle replica as cast. – **B** Failed attempt at fragmentation after heating and striking with a wooden hammer. – **C** Fragment obtained after reheating and striking with a chisel. – **D** Remaining fragment of the sickle. – (After Lago et al. 2023; photo to M. Cianfoni). – Scale 1:3.

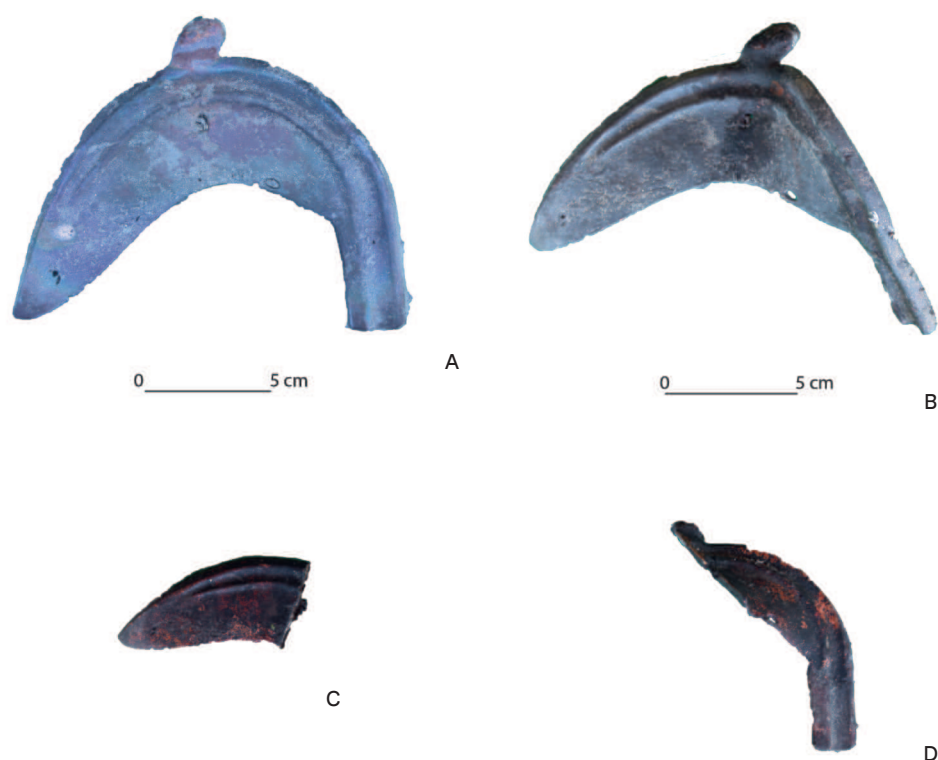
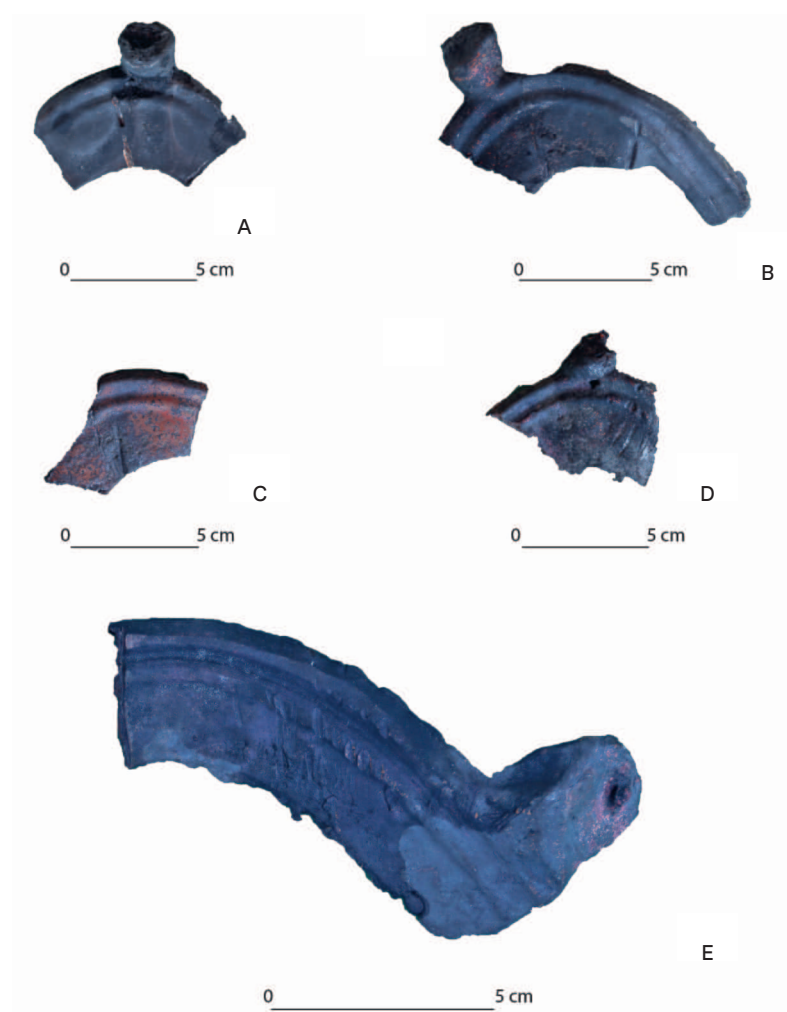


Fig. 2 Blow marks and notches accidentally produced during experimental attempts to obtain weight-regulated fragments from sickles. – (After Lago et al. 2023; photo M. Cianfoni). – A–D scale 1:3; E scale 3:5.



analysis to count whole objects, fragments, and matching fragments. This allowed us to gather a large amount of data to trace the spread of object fragmentation as a social and economic phenomenon during the Bronze Age (Lago 2020; Ialongo/Lago 2021; 2024).

The disadvantage of this approach is quite evident when it comes to characterizing the possible biographies of objects, losing any detail in terms of observations on use-wear and, especially, on the intentionality of the fragmentation itself. On the other hand, the advantages should not be underestimated, particularly in terms of the ability to collect significant amounts of data and perform statistical analyses using replicable methodologies.

From quantitative analyses made on several European countries (Lago 2022), we can now affirm that:

1. Fragmentation became relevant in the European Bronze Age at least by the Middle Bronze Age (fig. 3).
2. The fragmentation phenomenon appears to have similar characteristics in Central Europe and Italy.
3. No class of material is spared from the phenomenon of fragmentation (fig. 4).

4. When quantified, certain treatments – such as bending, twisting, or torsion of objects, signs of exposure to fire, folding (all classified as »damaging«) – as well as the presence of matching fragments, are very rare, generally below 5 % (Lago 2020; 2022, 202 figs 4–5).

These results can be considered descriptive and open to various and opposing interpretations. For example, can the pan-European spread of fragmentation be seen as evidence of shared cultic behaviour or as proof of the shared use of fragments as a medium of exchange in Middle and Late Bronze Age Europe? Could the apparent lack of selection in the collection and deposition of objects be interpreted as a deliberate choice somehow linked to the increasing rate of metal recycling, or is it evidence of the participation of different social groups in the rituals of fragmentation and deposition of hoards? Could the low rate of particular and seemingly non-functional »damaging« practices be related to a distinction between ritual scrap hoards and founders' hoards?

None of the proposed quantifications provides a definitive answer to these questions. However, there is one kind of data that may help us: the weight of the fragments.

Testing Theories: Metrological Analyses to Test the Null Hypothesis

So far, we have discussed the difference between ritual and utilitarian purposes. Two possible and alternative utilitarian purposes for fragmenting are those related to metal recycling (i. e. fragmentation carried out during the recycling process, or in anticipation of it to facilitate the collection and transport of fragments) and those related to breaking metal to fit certain weight standards. The latter function, which we could define as economic rather than purely utilitarian, does not explain the reasons for hoard burial, which could be either temporary or ritual (on this topic, see also de Marinis 2019). However, it has the significant advantage of being testable using statistical methods.

Ritual fragmentation and utilitarian fragmentation aimed at recycling, along with the intentionality of fragmentation, share the common assumption that the size and weight of the resulting fragments are unpredictable (Wiseman 2018). In the case of ritual fragmentation, one would expect to find completely random fragments. Given the »aimless violence« to which the objects are subjected (Nebelsick 2000), it is unreasonable to expect any dimensional or weight pattern. In the case of fragmentation aimed at recycling, we might expect fragments no larger than the size of the crucible, or perhaps we might think that the fragments actually recycled are those broken off from the object found in the hoard.

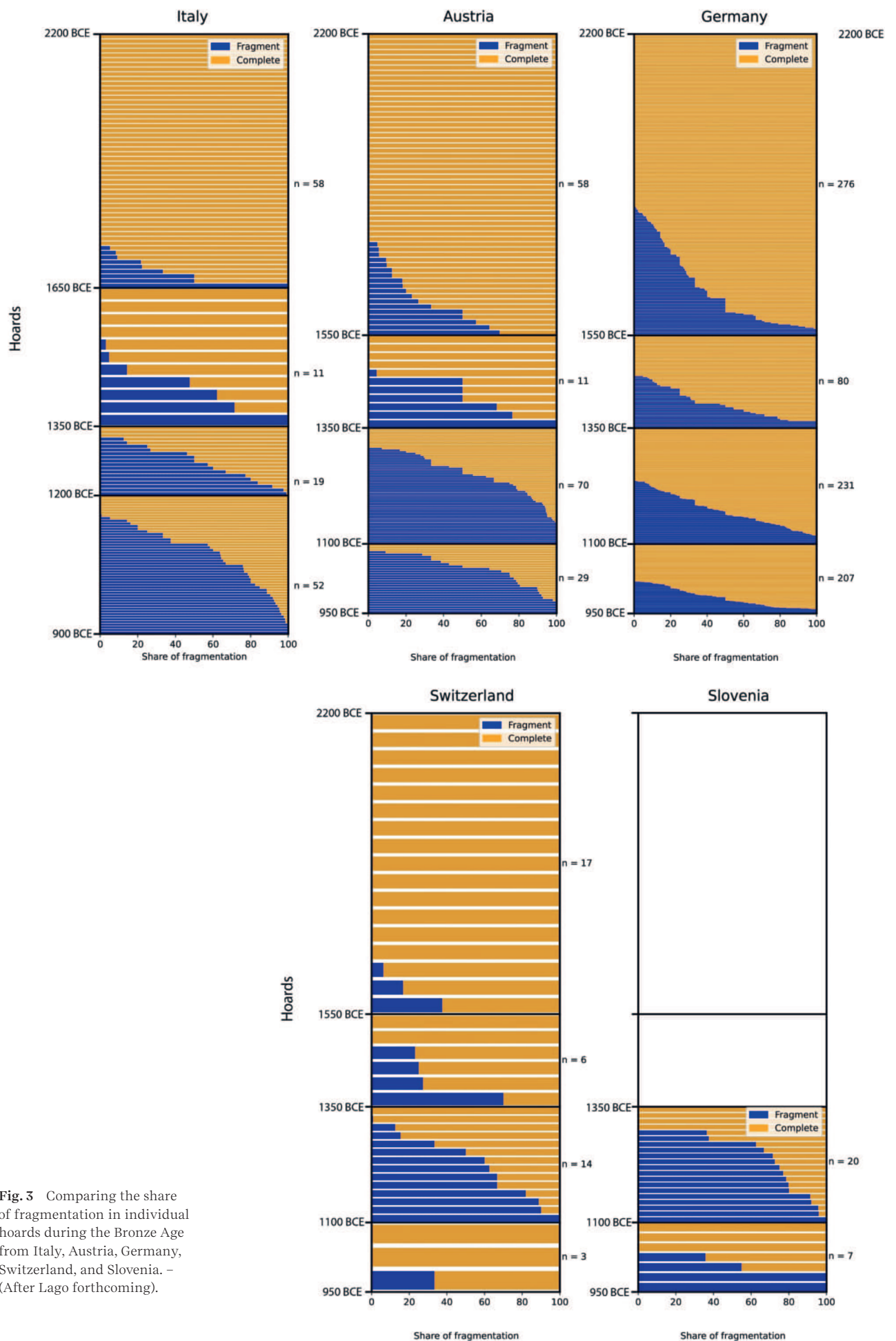


Fig. 3 Comparing the share of fragmentation in individual hoards during the Bronze Age from Italy, Austria, Germany, Switzerland, and Slovenia. – (After Lago forthcoming).

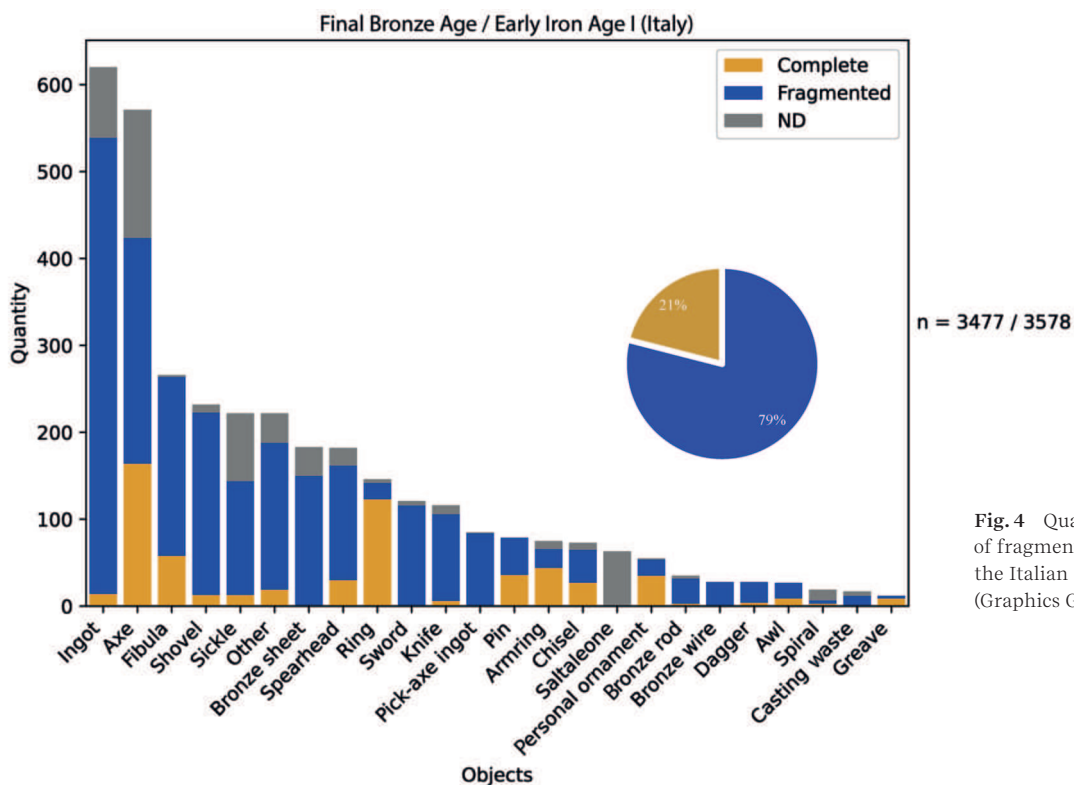
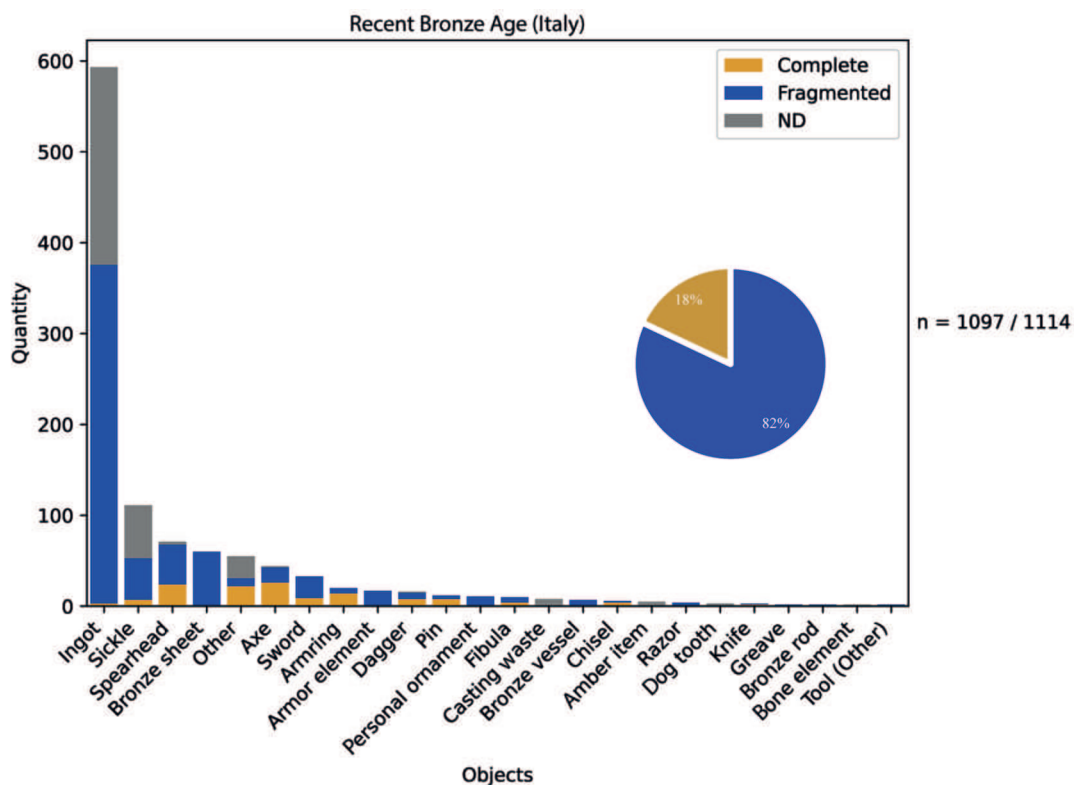


Fig. 4 Quantity and type of fragmented objects from the Italian Late Bronze Age. – (Graphics G. Lago).

In both cases, it is highly unlikely that the pieces would exhibit any weight regularity.

Therefore, the consistency of fragments' weight with any metrological pattern is evidence that sig-

nificantly reduces or rules out the possibility that the fragmentation had any objective other than an economic one.

Metrological Analyses on Fragmented Bronze

The hypothesis of fragments as currency is quite old (De Rossi 1884). However, the attempts to collect and analyse data on the weight of hoards have been surprisingly few in the long history of studies on the subject (Peroni 1966; Sommerfeld 1994; König 2004).

In addition to a more appropriate methodology, these analytical attempts required a reference framework that was still lacking at the time, as rightly pointed out by Ch. Pare: »Although the use of weighed metal in the Bronze Age seems plausible, the proposed system can hardly have functioned without standard weights. Suitable weights are, however, not documented in Central Europe until the end of the 2nd millennium BCE. Even then they are so rare that it is difficult to imagine their use in a pan-European system of metal exchange. The use of weighed bronze as commodity-money therefore remains hypothetical, even if the theory is attractive« (Pare 2013, 517).

The gap in knowledge about balance weights has been filled over the last 30 years (e. g. Cardarelli et al. 1997; 2001; 2004; Ialongo 2019; Ialongo/Rahmstorf 2019; 2022; Ialongo et al. 2021), and methodologies such as the Cosine Quantogram Analysis have been used (Kendall 1974), allowing for results whose statistical significance can be tested (Pare 1999; Ialongo et al. 2018; Rahmstorf 2019; Hermann 2022; Poigt 2022).

The Cosine Quantogram Analysis is a statistical method that allows for the discovery of whether one or more basic units exist within a numerical dataset. The results of the analysis are plotted on a graph, making it possible to determine if the dataset has a quantal or random distribution. However, to validate these results, a Monte Carlo simulation is used as a significance test, allowing us to determine the probability that the result is actually random. A Python script has recently been published that enables the Cosine Quantogram Analysis and the Monte Carlo test to be performed in a single environment by uploading an Excel file with the data (Lago et al. 2024).

In recent years, following intensive data collection campaigns, it has been possible to collect a database of over 30,000 objects from European Bronze Age hoards (Ialongo/Lago 2021; 2024; Lago 2020; **fig. 5**). This impressive amount of data, along with the aforementioned quantitative analyses, has allowed for a metrological analysis of large regions. Through the comparative study of weight systems and metrological patterns in the fragments, it has been confirmed that balance weights and fragmentation spread simultaneously across Europe, approximately from South to North (Ialongo/Lago

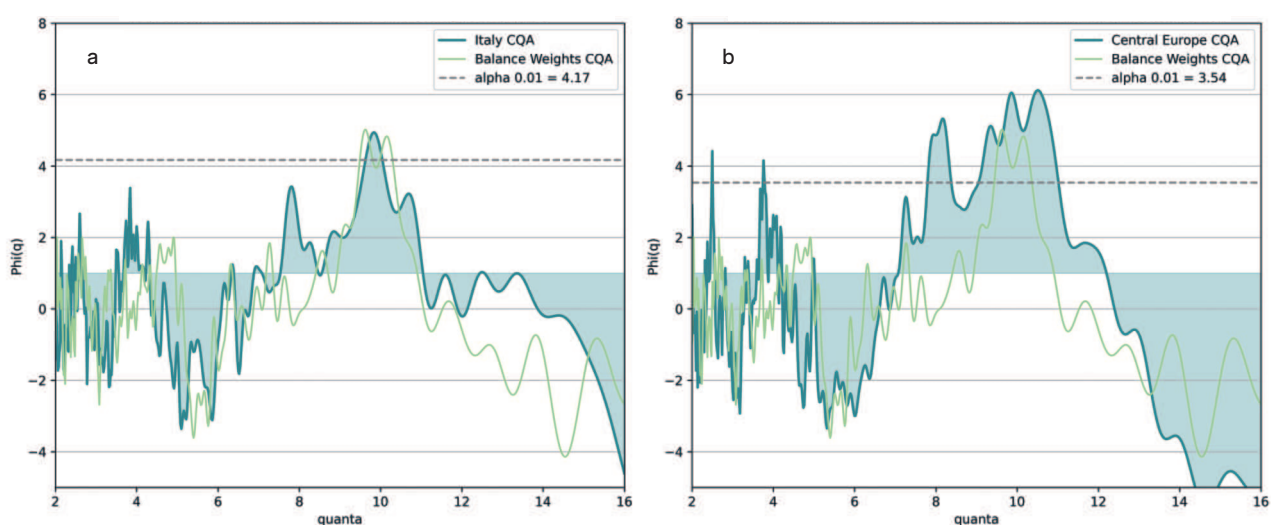


Fig. 5 Cosine Quantogram Analysis (CQA) and Monte Carlo simulations of Italian (a) and Central European (b) fragments from the Middle and Late Bronze Age. Comparison with the results of the Cosine Quantogram Analysis (CQA) of balance weights from the same period. – (After Ialongo et al. 2021, fig. 3; Ialongo/Lago 2024, fig. 4).

2024). From a metrological perspective, the Cosine Quantogram Analysis has allowed us to determine that fragmented bronze shares the same basic unit as balance weights and follows a consistent pattern of values (i. e. multiples of approximately 10 g). This

system appears to be shared between Italy and Central Europe, with small variations in value.

The results achieved strengthen the idea that weight analysis of fragments should serve as the null hypothesis to test against alternative explanations.

Discussion and Final Remarks

The conference held in Mainz once again highlighted how the topic of fragmentation remains compelling, lending itself to various approaches and open to multiple interpretations. Over the past 15 years, there has been renewed interest in this phenomenon, which inevitably contributes to the broader and equally captivating theme of hoarding – one of the most intriguing subjects in Bronze Age studies.

The introduction of methods borrowed from statistical and economic sciences has further fuelled the discussion on how to interpret fragmentation (Wiseman 2018). In this and other works, my colleagues and I have offered our perspective, interpreting the phenomenon of object fragmentation from an economic viewpoint and substantiating our interpretation with data and replicable methodologies (Ialongo/Lago 2021; 2024). It is evident that the weight of objects provides an objective parameter. When collected systematically and analysed using appropriate methodologies, it offers the remarkable potential to approach this issue scientifically. As always, the results leave ample scope for further debate and discussion. While I am convinced that much of the fragmented bronze circulating from the Middle

Bronze Age onwards is the consequence of the simultaneous introduction of weighing technologies, I do not believe we can entirely dismiss the possibility that other forms of fragmentation occurred. For instance, the deposition of de-functionalised weapons (Salzani 1994; 1998; Cupitò/Leonardi 2005) or the rare evidence of fragmented bronze found in smelting contexts (de Marinis 2006) – similar in many ways to those found in many »scrap hoards« (Bellintani et al. 2024; Huth 2024) – suggests a more complex archaeological reality than a single interpretation can explain.

Continued research on the topic will inevitably lead to new discoveries and new data to analyse. The addition of new data could allow quantitative and metrological studies to identify differences where none currently exist and to cover regions where data is currently scarce. It may become possible to reach a more precise characterization of the economic and social practices of Bronze Age communities. At the same time, new methodologies and theories will inevitably be introduced. What we are all presenting today might be just the tip of the iceberg of a much more complex phenomenon within ancient societies.

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The Banality of Fragments

Metal Fragmentation through the Ages and the »European Exception«

ABSTRACT

This article explores the phenomenon of metal fragmentation across Western Eurasia, with a focus on the European Bronze Age, challenging the often-supposed uniqueness of fragmentation practices in Europe. By comparing fragmentation patterns in Bronze Age Mesopotamia, the Roman Republic, and Viking Age economies, the study highlights the centrality of weight-regulated systems in the production and use of metal fragments. Fragmentation is shown to align primarily with the »monetary theory of fragmentation«, where deliberate breakage produced unstandardized fragments used as money in weight-based economies. Ritual interpretations account for only a minor portion of the evidence. The study argues that the primary purpose of fragmentation was economic pragmatism, facilitating exchange and integration into complex trade networks. Additionally, the study discusses the overlap between monetary and social theories, emphasising the performative role of metal fragments in creating economic and social bonds. In conclusion, the article argues that metal fragmentation in Bronze Age Europe aligns with broader Eurasian practices, contradicting its characterisation as a unique phenomenon. While the monetary theory of fragmentation emerges as the most robust explanatory framework, the study underscores the need for further research to disentangle the interplay of economic, ritual, and social factors. This nuanced understanding highlights the multifaceted roles of metal fragments in past societies, bridging quantitative data with theoretical interpretations.

KEYWORDS

Bronze Age Europe | Ancient Near East | Roman Republic | Viking Age | fragmentation | metals | money | ritual

The deliberate fragmentation of metal objects is a recurring phenomenon in archaeological records across diverse times and places, from the Bronze Age to the Medieval period. This practice has been interpreted in many ways, reflecting the varied cultural, economic, and symbolic roles of metal within different societies. In Western Eurasia, the fragmentation of metals, particularly bronze and silver, appears repeatedly in contexts where weight-regulated systems of exchange were prevalent. Fragmentation has been linked to trade, wealth redistribution, ritual practices, and even interpreted as a mechanism to establish social ties through the symbolic or practical use of fragments.

The motivations and mechanisms behind metal fragmentation remain a subject of debate. While some argue that fragmentation was primarily a utilitarian response to the demands of weight-based economies, others emphasise its ritual or symbolic significance. These perspectives are not mutually exclusive, as both economic and symbolic functions can coexist, shaping the practices and meanings associated with metal use.

This article explores the fragmentation of metal objects across Western Eurasia between c. 3000 BCE and c. 1000 CE, investigating the interplay between monetary and ritual theories of fragmentation. Drawing on evidence from hoards, sanctuaries,

and archaeological contexts, it evaluates patterns of fragmentation in Ancient Near Eastern economies, Roman Republican practices, and Viking Age hacksilver economies. The article then examines the »European exception« in the Bronze Age, where fragmentation has often been interpreted primarily through ritual frameworks. By comparing these contexts, the study challenges the view that European Bronze Age fragmentation represents a unique phenomenon disconnected from broader Eurasian traditions of weight-regulated metal use.

The findings underscore that, at least based on current research, the »monetary theory of fragmentation« provides the most comprehensive explanation for the largest part of the statistical variability observed in the archaeological record. While symbolic and ritual interpretations should not be entirely ruled out, the data predominantly support the hypothesis that fragmentation served pragmatic economic purposes.

Metal Fragmentation across Time and Space in Western Eurasia

Silver Fragmentation in the Ancient Near East

Silver served as the primary medium of exchange in the economies of the Ancient Near East from the Early Bronze Age (c. 3000 BCE) onward. Its role extended beyond a mere standard of economic value to an essential element of the economic system, deeply integrated with trade networks and public administrations. A distinctive feature of silver in this period was its utilitarian fragmentation and monetary use in weight-regulated transactions.

Silver as a Weight-Based Currency

The use of silver in the Ancient Near East revolved around its role as a medium of exchange, assessed strictly by weight. Transactions involving silver often entailed breaking down larger objects – ingots, jewellery, and other items – in order to obtain smaller fragments, whose value in weight was equivalent to the price of the good or service being purchased. This required thorough metrological control, ensuring its value was determined by its mass rather than its shape or condition (Powell 1996; Peyronel 2010; Rahmstorf 2016; Ialongo et al. 2018). Administrative texts dating to the early 2nd millennium BCE explicitly use the terms »scrap« (Akkadian *šibirtum*) and

»portion« (*sankuttum*) to indicate some of the most common forms in which silver was used in economic transactions (Arkhipov 2012).

Fragmentation was not a random process but complied with established weight standards. Analyses of hoards, such as the Middle Bronze Age silver hoard from Tell Mardikh/Ebla in Syria (c. 2000–1700 BCE), demonstrate that fragmented pieces comply with the Mesopotamian *shekel* of c. 8.3 g (Ialongo et al. 2018). This compliance highlights the sophisticated economic networks that relied on silver as a medium of exchange, integrating local and regional trade systems.

Silver and the Ancient Near Eastern Economy

Silver was embedded in a complex economic framework that combined market exchange, redistribution, and ceremonial gifting. It functioned simultaneously as a standard of value, a store of wealth, and a medium of payment. For example, Old Assyrian trade texts from Kültepe (prov. Kayseri/TR) (c. 2000–1700 BCE) reveal that silver was central to both small- and large-scale trade, enabling merchants to import goods such as tin and textiles, which were then exchanged for silver in Anatolia (Dercksen 2021).

This economic model required silver to be universally recognizable and divisible, leading to the

widespread fragmentation of silver items. The valuation of fragmented silver depended on the accuracy of scales and adherence to regional weight standards. This dual reliance on weight and standardisation allowed silver to circulate freely across diverse cultural and economic zones, from Mesopotamia to the Levant and beyond (Dercksen 2021; Peyronel 2010).

Hoardings and the Evidence for Silver Fragmentation

Hoardings provide critical insights into the use and fragmentation of silver. These deposits, often consisting of ingots, jewellery, lumps and fragmented pieces, reflect both the practical and symbolic roles of silver in ancient societies (Peyronel 2019).

Hoardings such as those from Acemhöyük (prov. Aksaray/TR) and Ebla typically contain a mix of intact and fragmented silver items. The Acemhöyük hoard, for instance, includes ingots and fragmented jewellery, likely kept for further monetary circulation (Özgüç 1995). The Ebla hoard, with its 171 items primarily composed of fragments and ingots, underscores the adaptability of silver for weight-based transactions (Ialongo et al. 2018).

Differences in hoard compositions across regions might reflect the local adaptation of silver use. While urban centres often housed standardised ingots, rural or frontier areas relied more heavily on fragmented silver, highlighting its utility in less formalised economies (Peyronel 2014).

Ritual and Symbolic Uses of Silver

Beyond its economic utility, silver held significant ritual and symbolic importance by virtue of its value. Deposits in sanctuaries and burial contexts often included silver items, fragmented or intact, suggesting their use in votive offerings or funerary practices. For example, the inclusion of fragmented silver in sanctuaries could symbolise wealth dedication to deities, reinforcing the societal and spiritual value attributed to silver (Özgüç 1995; Peyronel 2014). Such ritual uses underscore the multifaceted role of silver in Ancient Near Eastern societies. While it functioned as a practical medium of exchange, its symbolic associa-

tions with wealth and prestige elevated its status in ceremonial contexts. Silver, however, does not seem to have ever been ritually fragmented.

Bronze Fragmentation in Italy during the Republican Age

The Roman Republic's monetary system was characterised by the coexistence of weight-based practices and emerging coinage. Non-coined bronze currency in various forms – the so-called *aes* – was fragmented and used in weight-regulated transactions. Here I briefly review the role of fragmentation, the interplay between coins and weight-based bronze, and the evidence from hoards and sanctuaries, highlighting the economic and symbolic significance of bronze fragments.

Fragments and Coins in the Same Economy

Weight-regulated bronze currency remained central to the Roman economy even as coinage gained prominence. Early legal texts prescribe the payment of taxes and fines through unstandardised forms of *aes*, whose value was assessed through weighing. *Aes* was often fragmented to meet specific transactional needs. This fragmentation was not incidental but deliberate, reflecting the flexibility and adaptability of the weight-based system (Morgan 2014; 2020; Ialongo 2024).

More structured forms, such as *aes signatum*, introduced an element of standardisation through cast bars featuring symbols or motifs. Despite their uniformity, these bars were frequently fragmented, illustrating the persistent reliance on weight for valuation. Even cast coins like *aes grave*, which embodied state efforts to regulate monetary systems, were sometimes fragmented to fit the demands of a hybrid economy where weight-based practices coexisted with coinage (Neri 2004; Jaia/Molinari 2011).

Evidence from Hoards

Hoard compositions provide crucial insights into the coexistence of fragmented bronze and coins. These

deposits reflect the layered nature of the Republican monetary system. Hoards from urban and rural contexts typically contain a mix of fragmented *aes* and coins. Deposits from peripheral areas often lean heavily on fragmented bronze, highlighting the continued reliance on weight-regulated practices (e.g. Bertol/Farac 2012; Bertol 2014). In contrast, urban hoards show a more prominent presence of coins (Jaia/Molinari 2011; Murgan/Kemmers 2016).

The inclusion of fragmented coins within hoards underscores the practical need for flexibility in transactions. The deliberate fragmentation of *aes grave* demonstrates how weight-based practices persisted alongside the increasing use of standardised currency. This adaptability ensured that both older and newer forms of currency could meet diverse economic needs (Crawford 1985; Yarrow 2021).

Bronze Currency in Sanctuaries

Sanctuaries provide a distinct perspective on the use of bronze currency, bridging economic and ritual contexts. The deposition of bronze objects in sacred spaces underscores their dual role as both practical currency and symbolic offerings.

Sanctuaries such as Sol Indiges in Torvaianica, near Rome, and Bitalemi (Gela/IT) have yielded deposits of *aes rude*, *aes signatum*, fragmented bars, and coins. These finds suggest that bronze currency was not only used for economic transactions but also held symbolic value. Fragmentation within these deposits indicates that weight-based valuation remained important even in ceremonial contexts (Jaia/Molinari 2011; Tarditi 2016).

The presence of bronze in sanctuaries often reflects votive offerings, whereas the economic value of both *aes* and coins blended into its symbolic significance. Bronze fragments and coins deposited in these contexts may represent dedications intended to demonstrate wealth, fulfil vows, or seek divine favour. This symbolic role complemented the practical functions of bronze in economic settings (Murgan/Kemmers 2016; Tarditi 2016).

Silver Fragmentation in the Viking Age

The Viking Age, spanning the late 8th to early 11th centuries CE, was a period of remarkable economic dynamism and cultural interaction in Northern Europe. At the heart of the Viking economic system was silver, which functioned both as currency and as a medium of social exchange. Hacksilver, in particular, circulated as weight-regulated currency together with silver coins produced in Islamic polities in Europe.

The Role of Hacksilver

The term »hacksilver« refers to pieces of silver, often fragmented from larger objects such as coins, ingots, or jewellery. These pieces were cut or broken to serve as currency within a largely monetary economy in which the value of silver was quantified by weight (Kruse 1988; Kershaw 2014).

Archaeological evidence from sites such as Kaupang (Vestfold County/NO) and Hedeby (Kr. Schleswig-Flensburg/DE) demonstrates that weighed silver, including hacksilver, was a cornerstone of economic transactions. The widespread use of standardised weights highlights the sophisticated systems in place for regulating silver trade (Kilger 2008).

Silver Coins and Hacksilver: Complementary Systems

In Viking Age Scandinavia, hacksilver and silver coins coexisted, reflecting the interplay between bullion and coin economies. While regions such as England operated primarily within a coin-based system, the influx of foreign coins, especially Islamic *dirhams*, into Scandinavia led to their frequent fragmentation. This practice transformed coins into hacksilver, integrating them into the weight-based economy (Merkel 2016; Kershaw 2017).

The dual-currency system of the Danelaw in England, where both bullion and coins circulated, exemplifies this integration. Here, Scandinavian settlers maintained their traditional weight-based practices while adapting to the local coinage systems. Coins often served as a reserve of silver that could be melt-

ed down or fragmented to meet the demands of the weight-based economy (Kruse 1988; Kershaw 2017).

Hacksilver in Hoards

Hoards typically contain a mix of coins, ingots, jewellery, and hacksilver. Their composition provides insights into the economic practices and cultural values of Viking societies. The Barrow-in-Furness (Cumbria/GB) and Silverdale hoards (Lancashire/GB), for instance, illustrate the accumulation of wealth through plunder, trade, and tribute. The inclusion of fragmented silver alongside intact objects suggests both the practical and symbolic roles of silver in Viking society (Kershaw 2014). Similarly, hoards from the large settlements of Kaupang and Hedeby highlight the use of silver as a versatile medium for both large-scale and everyday transactions (Kilger 2008; Merkel 2016).

In many hoards, the deliberate fragmentation of silver is evident, with pieces cut to specific weights. This practice aligns with the use of standardised weights and indicates a high degree of economic

sophistication. The variability in hoard composition across regions further underscores the adaptability of Viking economic systems to local conditions (Kruse 1998; Kilger 2008).

Regional Variations and Long-Distance Trade

The Viking Age economy was deeply interconnected with long-distance trade networks that extended from the Islamic Caliphate to the British Isles and the Baltic. Islamic *dirhams*, often found in fragmented form, played a crucial role in these networks, serving as both currency and a source of raw silver. At Kaupang, the inflow of *dirham* silver marked a shift towards greater reliance on weighed silver. This trend mirrored broader economic changes in Scandinavia, where increased silver availability from eastern trade routes facilitated economic expansion and urbanisation. Hedeby, another major trading hub, also underscores the significance of imported silver. Archaeometric analyses reveal extensive recycling and refining of foreign silver to meet local economic demands (Merkel 2016).

The »European Exception«

Fragmentation theories on diverse pre- and proto-historic contexts in Western Eurasia are remarkably aligned in interpreting metal fragments as money. The act of fragmentation serves the main purpose of producing easily manageable pieces of metal – any metal, precious or less so – whose exchange value was assessed through weighing. At the same time, hackmetal money still retains symbolic value and occurs in ritual contexts.

The scholarly tradition on metal fragmentation in Bronze Age Europe follows a different path. The deliberate destruction of objects has been predominantly interpreted as a symbolic or ritual act, reflecting social, religious, or cosmological meanings rather than economic pragmatism (Brandherm 2018). Studies emphasising the economic underpinnings of fragmentation also have a long tradition, but they always remained somehow on the fringes of the ac-

ademic discourse, at least until very recently. Here I do not address the connection between fragmentation and recycling. In recent times, such a connection has not been the focus of interpretive syntheses, and lost much of its popularity in favour of ritual interpretations. Nonetheless, the recycling hypothesis is usually considered a likely option alongside the prominent ritual explanation, although with some exceptions (e. g. Hansen 2016).

This section critically examines these interpretations, focusing on well-known, influential studies addressing ritual theories of fragmentation, enchainment, and monetary frameworks. By comparing the European case to the broader Eurasian framework, it builds the groundwork to evaluate whether the European Bronze Age truly represents an exception or if similar economic mechanisms underlie the fragmentation phenomenon.

The Ritual Theory of Fragmentation

The deliberate fragmentation of metal objects during the European Bronze Age is often seen as a symbolic practice deeply embedded in the social and religious fabric of the period. The intentional breaking of metal objects is often thought to transform them from functional items into symbols of social, ritual, and cosmological significance.

Objects like swords, axes, ornaments, and tools, which held practical value in daily life, were deliberately rendered unusable. This act of breaking signified the »death« of the object, allowing it to transcend its functional role and take on a new identity within a ritual or symbolic context. According to some scholars, fragmentation could mirror human life cycles, with objects undergoing a process of destruction akin to death and a subsequent rebirth in the spiritual or communal sphere (Metzner-Nebelsick 2012; Brück 2016).

An important symbolic dimension of fragmentation is the *pars pro toto* argument, where a part of the whole object, representing its entirety, is dedicated in hoards. The deliberate separation of fragments may have allowed certain pieces to circulate as symbols or retain the power of the original whole. This practice imbued individual fragments with a shared or residual connection to the complete item, creating a physical and symbolic link across time and space (Bradley 2013; Hansen 2016).

Such symbolism is sometimes connected to the broader worldview of Bronze Age societies, where material objects were often imbued with life-like qualities. Fragmentation, then, may have been seen as a way of »freeing« an object's essence or spirit, allowing it to participate in rituals meant to mediate between humans and the divine (Nebelsick 2000; Bradley 2013).

Ritual Violence and Performance

L. Nebelsick (2000) introduces the concept of »ritual violence« to describe the deliberate and often dramatic destruction of metal objects in Bronze Age

hoards. In a few cases, weapons, tools, and ornaments exhibit signs of systematic and purposeful damage – bent swords, shattered axes, and twisted bracelets are common features in these assemblages. Such destruction was systematic; it often involved methods that showcased skill and intention, such as heating and bending metal until it fractured or delivering precise blows to specific parts of an object (Bradley 2013; Hansen 2016).

This alleged ritualised violence is assumed to carry significant symbolic weight. The act of breaking an object could serve as a performative gesture, expressing themes of sacrifice, transformation, and renewal. By destroying valuable items in controlled and visible ways, participants in these rituals reinforced communal identities and social cohesion (Metzner-Nebelsick 2012; Bradley 2013). The intentionality of these acts, as argued by R. Bradley, aligns with broader ritual practices where destruction was not wasteful but rather deeply meaningful.

Fragmentation and Social Hierarchies

Fragmentation is generally thought to have been orchestrated by social elites who controlled the production and use of valuable metal objects. As C. Metzner-Nebelsick (2012) argues, these elites often directed rituals involving the destruction of wealth, using these acts to display their power and reinforce their status (Metzner-Nebelsick 2012; Bradley 2013). By breaking and offering valuable items, they demonstrated their ability to transcend material wealth and act as intermediaries between their communities and the divine (Metzner-Nebelsick 2012; Brück 2016).

This control over fragmentation could also serve to redistribute social value. In societies with significant economic inequalities, the destruction of high-value items in public rituals may have functioned as a means of levelling wealth disparities, at least symbolically. The act of fragmentation thus carried both social and political implications, reinforcing communal ties while legitimising the authority of those who directed the rituals (Nebelsick 2000; Bradley 2013).

The Relationship between Fragmentation and Deposition

Although the act of fragmentation can be studied in isolation (Brandherm 2018), it is often considered to be deeply intertwined with the practices of deposition and hoarding. Fragmented objects were rarely left in isolation; they were typically collected and deposited in rivers, bogs, or dryland hoards. This interplay between fragmentation and deposition would underscore the deliberate and meaningful nature of both practices (Bradley 2013; Hansen 2016).

Fragmentation is also sometimes seen as a prerequisite for deposition. By breaking objects, their creators or owners prepared them for their final journey, removing them from the sphere of human use and rendering them suitable for the divine or ancestral realms (Bradley 2013; Brück 2016). In some cases, fragmented items were deposited alongside intact objects, suggesting a complex interplay of meanings. As Bradley notes, the juxtaposition of broken and complete items in hoards may reflect differing ritual purposes or stages of an object's life cycle (Metzner-Nebelsick 2012; Bradley 2013).

The Enchainment Theory of Fragmentation

J. Chapman's »Fragmentation in Archaeology« (2000) presents a comprehensive framework for understanding fragmentation in prehistoric contexts, emphasising its social and symbolic dimensions. Chapman's focus on deliberate breakage as a key element of material culture aligns with several ideas in the articles analysed previously but also diverges in meaningful ways, particularly regarding the theoretical underpinnings and the integration of the concept of enchainment.

Alignment with Ritual and Symbolic Interpretations

Chapman's argument that fragmentation is central to the social practices of prehistoric communities resonates strongly with the views expressed by

authors such as Brück (2016), Nebelsick (2000), and Metzner-Nebelsick (2012). Like these authors, Chapman rejects the notion that fragmentation was purely accidental or utilitarian. Instead, he emphasises the structured nature of fragmentation and its deliberate use in creating and reinforcing social relationships.

Chapman's notion that fragmented objects maintain a connection to their original whole aligns closely with the *pars pro toto* argument presented in Brück's and Bradley's works. For Chapman, the fragmented parts of objects act as material extensions of relationships, connecting individuals across time and space.

Divergence in Theoretical Frameworks

Despite these similarities, Chapman's approach diverges from other authors in significant ways, particularly through his theoretical emphasis on enchainment and accumulation. While others primarily focus on the symbolic and ritual dimensions of fragmentation, Chapman frames it within a broader anthropological context, drawing on concepts such as inalienability and the fractal nature of social identities.

Chapman's concept of enchainment introduces a dynamic framework where fragmented objects are not merely symbolic but serve as active agents in creating social bonds. This perspective goes beyond the ritual emphasis found in Nebelsick (2000) and Metzner-Nebelsick (2012) by suggesting that fragmentation is integral to the negotiation of social relationships over time. In this sense, fragmentation is not just an endpoint but a process that continuously reshapes social and material networks.

Unlike the authors who emphasise deposition and ritual contexts, Chapman dedicates significant attention to the role of accumulation in prehistoric societies. He argues that fragmentation allows for the creation of »object sets« that are key to both individual and collective identity formation. This idea diverges from Bradley's (2013) focus on deposition as the culmination of fragmentation, proposing instead that fragmented objects retain agency even within accumulated contexts.

The Monetary Theory of Metal Fragmentation

The monetary theory of fragmentation assumes that the deliberate breakage of bronze objects in the European Bronze Age was closely tied to the commodification of metal and its use as weight-regulated money. By breaking objects into standardised fragments, communities created divisible and portable units of exchange that facilitated trade and the accumulation of wealth.

Fragmentation as a Mechanism for Commodification

The intentional breaking of bronze objects into smaller, manageable pieces allowed metal to transition from a material used for tools, weapons, and ornaments to a commodity with standardised value. Ch. Sommerfeld (1994) emphasises that fragmented pieces from hoards often conform to specific weight standards, indicating their use as a form of money. This standardisation of fragments enabled communities to use them as a medium of exchange in trade, much like *aes* and early coinage in later periods (Primas 1986; Sommerfeld 1994).

This practice also correlates with the adoption of weighing technologies across Europe. Ch. Pare (2013) highlights the importance of weighing scales and standard weights, which were first introduced in Mesopotamia and later adopted in Europe during the Bronze Age. These tools allowed communities to quantify fragmented metal precisely, facilitating its integration into complex trade systems. The deliberate fragmentation of objects, when combined with weighing, created a shared system of value that enabled efficient and consistent transactions (Pare 2013; Rahmstorf 2016).

Weight-Based Regulation

Weight-based regulation was central to the commodification of fragmented metal. R. Peroni (1998) suggested that many fragmented pieces found in European hoards conform to consistent weight units. M. Primas (1986) discusses the intentionali-

ty of weight calibration in Bronze Age hoards. She notes that several hoards contain fragments that correspond to multiples or fractions of recurrent weight values, underscoring their function as tradable units. For example, sickle fragments in Northern Europe frequently match specific weight categories, suggesting their deliberate fragmentation for use in economic transactions (Malmer 1992; Primas 1986).

Weight-based regulation also highlights the technological advancements of Bronze Age societies. Ch. Pare (2013) and L. Rahmstorf (2006) argue that the use of fine balances and small weights indicates an increasing emphasis on accurate measurement. These tools facilitated the creation of fragments that adhered to recognized standards, ensuring their acceptance across diverse trade networks.

The Role of Fragmentation in Trade

Fragmented metal played a vital role in facilitating long-distance trade by providing a portable and divisible means of exchange. Sommerfeld (1994) notes that many hoards containing fragmented objects are located near possible trade routes or resource-rich regions, suggesting that fragmentation was integral to interregional trade networks. For example, the distribution of sickles and torcs across Central and Northern Europe would align with key trade hubs, reinforcing their role as standardised commodities (Sommerfeld 1994; Peroni 1998).

Pare (2013) argues that fragmented metal served as a medium of exchange, particularly in the trade of high-value goods such as tin, amber, and exotic materials. By enabling the quantification and commodification of metal, fragmentation allowed Bronze Age communities to establish more complex and efficient economic systems (Pare 2013).

The Intersection of Economy and Ideology

The use of fragmented metal as money would reflect not only economic pragmatism but also ideological shifts. Pare (2013) and Sommerfeld (1994) suggest that the deliberate fragmentation of objects into tradable units was influenced by both practical and cultural factors. Fragmentation could also have

allowed communities to redistribute wealth within groups and facilitate the negotiation of social or religious obligations through the exchange of standardised pieces. This process bridged the economic and social spheres, reinforcing the role of metal as a carrier of symbolic and practical value (Sommerfeld 1994; Malmer 1992).

Primas (1997) argues that the creation of weight-standardised fragments represents an early form of economic ideology, where value became abstracted from the object itself and linked to its measurable properties. This abstraction marked a significant departure from earlier forms of wealth exchange, such as gift-giving, and laid the groundwork for more formalised economic systems in later periods.

Quantitative Patterns in Metal Fragmentation in Bronze Age Europe: Archaeological Evidence

Here I briefly introduce recent evidence of metal fragmentation in Europe during the Bronze Age, emphasising measurable characteristics and statistical patterns observed across Europe. The focus is on quantitative data, including fragmentation rates, weight distributions, spatial analyses, and hoard compositions.

Fragmentation Rates and Chronological Trends

Quantitative studies reveal an increase in the rate of fragmentation over time. In continental Europe, during the Early Bronze Age (2300–1500 BCE), hoards typically contained complete objects, comprising over 90 % of recorded assemblages. By the Late Bronze Age (1300–800 BCE), fragmented items accounted for 75–80 % of deposits (Lago 2020; Ialongo/Lago 2021). This shift coincides with the spread of weighing technology, suggesting a relationship between metal fragmentation and evolving economic systems.

Knight's (2019 and in this volume) analysis of British assemblages supports these findings, documenting a marked increase in the deliberate destruction of weapons, particularly swords and spearheads, during the Late Bronze Age. These objects exhibit signs of bending, crushing, and deliberate breakage prior to deposition.

Weight-Based Regulation and Standardisation

Statistical analyses of fragmented bronze objects demonstrate strong alignment with weight systems. The Cosine Quantogram Analysis (CQA) of hoards in Central and Southern Europe identifies recurring weight peaks at intervals of c. 10 g, corresponding to a pan-European weight unit (9.4–10.2 g) consistent with balance weights from the same period (Ialongo/Lago 2024; see also Lago in this volume).

Experimental studies corroborate these findings. G. Lago et al. (2023) conducted controlled fragmentation of replica sickles, producing fragments that conformed to established weight intervals. These results match data from 1,500 archaeological sickle fragments, confirming that weight regulation was a deliberate practice in the fragmentation process. The widespread adoption of this practice across diverse regions indicates a shared metrological system, likely tied to the development of long-distance trade networks.

Finally, quantitative analyses reveal regular statistical patterns in fragments. The weight values of metal fragments in hoards are log-normally distributed, an outcome that simulations demonstrate cannot be due to chance (Ialongo/Lago 2024).

Fragmentation and Hoard Composition

Objects in British hoards appear to be randomly collected, with no clear evidence of selection criteria (Wiseman 2018). This suggests that hoards reflect a statistically significant sample of all the forms in which bronze circulated at the time of their deposition.

By the Late Bronze Age, fragmented objects accounted for the majority of items in hoards. Analyses of Italian hoards (Lago 2020) and Central European deposits (Ialongo/Lago 2024) indicate that fragments typically constituted 75–80 % of the total assemblages.

The data show that every object could be fragmented, with no exception (see Lago, this volume). Tools (e.g. sickles, chisels) and ingots are the most

commonly fragmented items in many hoards. Weapons, including swords and spearheads, are also frequently found as fragments, particularly in Northern and Western Europe. Knight's (2019) experimental studies demonstrated that such weapons were often intentionally damaged through bending or crushing prior to deposition, suggesting consistent fragmentation practices across regions.

One striking pattern is the low occurrence of matching fragments within the same hoard. N. Ialongo and G. Lago (2021) report that less than 5 % of fragmented objects in Italian and Central European hoards can be reassembled, indicating that fragments were widely circulated before deposition. This suggests a complex life cycle for fragmented objects, involving multiple exchanges or uses before their final deposition.

Discussion and Conclusions

Metal fragmentation across Western Eurasia reflects a blend of economic and symbolic practices, but the evidence strongly supports weight-regulated monetary use as the primary driver. Here I summarise the findings, emphasising the monetary theory's ability to explain the majority of the data while acknowledging the potential coexistence of ritual practices.

The data from Bronze Age Europe show that:

- 1) metal fragments comply with multiples of a weight unit;
- 2) hoards rarely contain matching fragments of the same object (c. 5 %);
- 3) the selection of fragmented objects in hoards is random;
- 4) all known object types are fragmented;
- 5) the weight values of bronze fragments are log-normally distributed.

The role of theory is to explain the observed data. It follows that a reliable theory of fragmentation must provide satisfactory explanations for the observed archaeological evidence. The monetary theory of fragmentation is clearly the best-suited one to fulfil

this criterion. Bronze fragments comply with weight systems because weight was the measure of their value. Matching fragments in hoards are rare because the purpose of fragmentation was circulation, not deposition. All types of objects are fragmented because the original shape was irrelevant to determine the monetary value of fragments. And finally, their weight values are log-normally distributed because supply, demand, income, and consumption were as well (Ialongo/Lago 2024).

The ritual theory, on the other hand, explains very little. Weight-based regulation is never mentioned, and hence has no role in this theory. It assumes selection of the objects to be fragmented, but all objects eventually are. It also assumes that fragmentation is random, but the data clearly show that it is not. The ritual theory only offers explanation for the rarity of matching fragments in the same hoard, through the *pars pro toto* argument. This argument, however, relies on a circular argumentation: *pars pro toto* of symbolically-charged objects are buried in hoards because hoards are votive depositions, and hoards are votive depositions because they contain *pars pro toto* of symbolically-charged objects. The ar-

gument is, at the same time, proof and consequence of the ritual nature of hoards.

In summary, there is no evidence that the fragmentation phenomenon in Bronze Age Europe has a different explanation than metal fragmentation in any other historical period across Western Eurasia. That is, the main function of metal fragmentation in Bronze Age Europe was likely to produce weight-regulated fragments to be used as money.

The ritual hypothesis, however, must not be dismissed altogether (Brandherm 2018). The data exclude that ritual fragmentation was the rule, but this neither means that hackmetal money could not have been employed in rituals, nor that ritual fragmentation never occurred. In other words, the evidence simply shows that monetary fragmentation is responsible for the largest part of the statistical variability of the data, but it does not exclude that different processes were concurrently at work. We might not be able to pinpoint these different processes yet because their quantitative footprint is hidden behind the stronger visibility of monetary patterns of fragmentation. As fragmentation patterns in Bronze Age Mesopotamia, Republican Italy, and Early Medieval Northern Europe demonstrate, hackmetal money often finds its way in ritual contexts, and is always charged with symbolic meaning simply by virtue of it being money. The current difficulty in pinpointing statistically-relevant, ritual fragmentation patterns

might simply depend on the fact that quantitative research aimed at disentangling different purposes of fragmentation is still in its infancy (Knight 2021; Lago 2020; Lago et al. 2023).

Enchainment theory, on the other hand, has a remarkable point of contact with the monetary theory of fragmentation. While it still does not account for the statistical variability of the data, the idea that fragments fulfil a performative role in creating bonds between human agents pretty much describes what money does in practice. Money was never the cold and impersonal tool that many archaeologists believe it to be. It creates bonds between individuals that are mediated by power, trust, and kinship, and it does it through one of the most common – and frankly banal – instances of social relationships: economic transactions (Bloch/Perry 1989; Beckert 2011; Baron/Millhauser 2021).

In conclusion, while the monetary theory of fragmentation emerges as the most robust framework for explaining the majority of the evidence, this does not negate the complexity of the phenomenon. Future research should continue refining methodologies to disentangle the interplay of economic, ritual, and social practices. By bridging the gaps between quantitative data and theoretical interpretations, we can deepen our understanding of the nuanced roles that metal fragments played in the societies of Bronze Age Europe and beyond.

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Fragmentation and Rituals

Not so Different!

A Comparative Study of Fragmentation in Bronze Age Hoards in the Region of Salins-les-Bains

ABSTRACT

The exact function of Bronze Age hoards and the role of metal object fragmentation remain poorly understood due to their diversity and the often accidental and isolated nature of the discoveries. To better understand these practices, a systematic study has been conducted over the past 20 years around the hilltop site of the Camp du Château in Salins-les-Bains. This active and organised research, conducted within a legal framework, has documented a significant number of discoveries, enabling a comparative analysis of hoards from different phases of the Bronze Age, with varying degrees of object fragmentation. The findings show that, in terms of burial methods and selected topographical contexts, fragment hoards do not appear to hold a different significance from other types of hoards with more symbolic compositions. While not excluding the possibility of economic or pragmatic functions in some cases, several arguments suggest that the hoards and the fragmentation of objects may have been part of a ritualised social practice, potentially related to the territorial marking of the fortified site.

KEYWORDS

Eastern France | Jura | Bronze Age | hoards | fragmentation

Fragmentation is ubiquitous in Bronze Age hoards, but it is extremely difficult to explain due to the impossibility of proposing a single interpretation for all hoards. Many questions arise: was the hoard intended to be temporary or permanent? Was the fragmentation of the objects specifically carried out for the hoard, or was it simply the result of a collection of already broken objects? Were the objects broken for practical reasons or as part of codified rituals? At present, these questions have no single answer, and hoards (and through them, the role of fragmentation) are interpreted differently depending on their composition and the perspectives of researchers, who generally favour either a symbolic or a practical interpretation.

In eastern France, the assemblages from the early Late Bronze Age are characterised by a large number of small fragments from a variety of objects. We may

wonder whether these fragment hoards, often referred to as »scrap hoards«, served a different function compared to other phases where the finds tend to present assemblages with high social value. The difficulty in answering this question lies in the fact that hoards are most often independent discoveries, making it challenging to understand the practice of hoarding as a unified phenomenon.

The very singular case of the Salins-les-Bains area (département Jura/FR), where a research for Bronze Age hoards has been conducted for about 20 years, allows for a local comparison of the practice of metal hoarding across different phases of the Bronze Age. Benefiting from systematic research and documentation of rare quality for non-funerary hoards, this case study allows for an examination of various aspects of hoarding practices: the composition, the rate and intensity of fragmentation, the arrangement of objects,

as well as the topographical position and context of the hoards, and the choices of location at the scale of the micro-region. The choices related to the com-

position of the assemblages will thus be compared with other relevant criteria for understanding metal hoards.

Fragmentation and the Interpretation of Bronze Age Hoards

Fragmentation is a recurring phenomenon in non-funerary Bronze Age hoards across Europe. Regardless of the phase or region, many buried artefacts are incomplete or mere fragments, sometimes representing only a small portion of the original objects. In most cases (except for accidental breakage at the time of discovery), it is certain that the pieces were broken before burial, but it is unclear whether the objects were selected from already broken items from the circulating stock, or whether fragmentation was specifically carried out for the hoard.

The presence of fragmented objects takes part in a longstanding debate between functional or economic interpretations of hoards, on the one hand, and social, symbolic, or religious interpretations, on the other hand. The former consider fragmentation as the result of a collection of already broken objects or a deliberate cutting of pieces to standardise their size or weight, for remelting or future exchanges – a wholly pragmatic act, in other words. The latter interpretations associate the hoard with the consecration of specific places, as crossing points or boundaries, or identify it as a votive offering to a deity, or as the affirmation of social ties, the commemoration of specific individuals, particularly in the context of rites of passage – i. e. a set of practices in which fragmentation plays a highly codified symbolic role. Discussions on the nature, role, and timing of fragmentation have been thoroughly explored in several key works, so there is no need to revisit them in detail here (Sommerfeld 1994; Chapman 2000; Nebelsick 2000; Bradley 2005; Blitte 2015; Brandherm 2021). However, we will briefly note that these two families of interpretations fundamentally differ in several aspects, primarily concerning the intended future of the hoard. Indeed, if hoards were formed as stocks of raw material to be recycled or exchanged, the hidden

objects were meant to be retrieved one day; however, ultimately, they never were. The hoard was thus by nature intended to be temporary. In contrast, the hoarding of objects within ceremonial practices was to result in their permanent burial. The value of the objects is also considered fundamentally differently: in the case of forming a stock of raw material, the original form of the items is no longer important; only the economic value of the metal then matters. Conversely, in a symbolic hoard, the nature, shape, and social value of the objects are necessarily significant.

The opposition between proponents of economic-pragmatic hypotheses and socio-religious hypotheses naturally impacts the interpretation of the role of fragmentation. Recent studies using experimentation suggest that the fragmentation observed in metal hoards was largely the result of intentional acts (Knight 2022), reducing the likelihood of a simple collection of already broken objects. However, it remains true that voluntary fragmentation can apply both to the intention of crushing objects for subsequent remelting or to transforming them to align with cultural beliefs.

In reality, the vast diversity in the size, composition, and level of fragmentation in non-funerary metal hoards does not lead to a single interpretation for all discoveries. Some hoards, composed of new, intact objects with functions suggesting privileged or prestigious social roles, are more likely to favour social or religious interpretations, while other highly fragmented hoards are more readily interpreted as metal stocks destined for remelting. This is especially true for large collections of fragments from a wide variety of categories of objects. Most of these hoards are considered raw material stocks, as the value of this »scrap metal« seems more plausibly

linked to the mass it represents rather than to its nature, according to our modern perspective. As early as the late 19th century, E. Chantre referred to them as »foundries« (Chantre 1875). G. de Mortillet later clarified that their true name should be »founder's hideout« (»leur véritable nom doit être cachette de fondeur«, de Mortillet 1894, 338). One of the most emblematic examples from eastern France is the mid-Late Bronze Age hoard from Larnaud (départ. Jura/FR), which contains more than 1,800 pieces, most of them broken (Coutil 1914; Piningre et al. 2023).

However, in eastern France, this type of fragment hoard is especially characteristic of the early Late Bronze Age (Bz D–Ha A1). Indeed, the composition of hoards in this region follows a relatively clear evolution, similar to that of other nearby regions within the northern Alpine domain (Mordant 1998; Piningre 1998; Ducreux et al. 2025; Bordas et al. 2025). The hoards of the Early and Middle Bronze Age are mostly composed of intact objects or minimally fragmented, especially flanged axes or palstaves. Towards the end of the Middle Bronze Age, fragments of plano-convex ingots and axe-ingots complete the assemblages. The hoards of Lons-le-Saunier (départ. Jura/FR) (Milotte 1963, 310), Ternay (départ. Rhône/FR) (Chantre 1873), Granges-sous-Grignon (départ. Côte-d'Or/FR) (Nicolardot/Verger 1998), and Biederthal (départ. Haut-Rhin/FR) (Piningre 2007) are characteristic. Axes remain predominant, and sickles become frequent, particularly along the Jura border (Piningre/Grut 2009).

A profound change in the composition of hoards occurs in the early Late Bronze Age (Bz D2–Ha A1), in which the assemblages are often larger and include a much greater variety of objects, with fragmentation being exacerbated. Among the most remarkable examples are the hoards from Cannes-Ecluse (départ. Seine-et-Marne/FR) (Gaucher/Robert 1967), Longueville (départ. Seine-et-Marne/FR) (Lamarre 1945), Dom pierre-les-Ormes (départ. Saône-et-Loire/FR) (Gaucher 1981, 365), Publy (départ. Jura/FR) (Milotte 1963, 331), Rigny-sur-Arroux (départ. Saône-et-Loire/FR) (Gaucher 1981, 368), and Beaujeu (départ. Haute-Saône/FR) (Milotte 1963, 266). In the subsequent phases of the Late Bronze Age, although this type of hoard does not

disappear, it becomes less frequent, and the degree of fragmentation decreases. Moreover, in the middle and late phases of the Late Bronze Age, hoards with a much clearer composition also appear: female equipment hoards, such as those from Blanot (départ. Côte-d'Or/FR) (Verger 1998), or Mathay (départ. Doubs/FR) (Piningre/Ganard 2021), and warrior equipment hoards, such as those from Vénarey-les-Laumes (départ. Côte-d'Or/FR) (Verger 1992) or Briod (départ. Jura/FR) (Gauthier 2003), as well as thematic hoards (the Evans hoard [départ. Jura/FR] consists of a set of metal ware, Piningre et al. 2015; the Marmesse hoard [départ. Haute-Marne/FR] consists of a series of armours, Mohen 1987). The social character of these assemblages is clear.

These significant variations in composition may lead us to think that the function of hoards may have differed depending on the phases or circumstances, suggesting that they did not all necessarily meet the same needs or that they may have combined symbolic and practical acts within much more complex practices than previously envisaged (Verger 2006). But do fragment hoards truly stand apart from more clearly symbolic or social hoards when other criteria are considered, such as deposition modes or location choices?

The modes of burying of non-funerary metal hoards are still poorly understood due to the fact that they are often old and accidental discoveries, and they have rarely been observed *in situ* by specialists. However, the main limitation to a more global understanding of the hoarding phenomenon is that we are relying on dispersed and unrelated discoveries. Indeed, there is nothing to prevent us from considering that hoards may have served different objectives if we can only consider each one individually. This is why it seems interesting to analyse the practice of metal hoarding through a remarkable case study, which allowed for the discovery and excavation of a large number of metal hoards: the research programme conducted over the last 25 years in the region of Salins-les-Bains. Systematic metal detector surveys have provided not only valuable information on burial methods but also a broad view of the distribution of discoveries on a micro-regional scale.

A Particular Case Study in Eastern France: the Research Programme Conducted in the Region of Salins-les-Bains

The Salins-les-Bains area occupies a strategic position along the western edge of the Jura Mountains. Located between the Saône plains and the first plateaus, it represents a favoured route towards the interior of the massif, heading towards the Swiss Plateau. This area is also of interest due to its proximity to the salt springs from Triassic marls, which have been exploited since the Neolithic, particularly in the 15th–14th centuries BCE (Pétrequin et al. 2001). Its contrasting topography is characterised by deep valleys bordered by steep plateaus, isolated mounds, and sometimes relatively high mounts. The entrance to this valley is notably dominated by a protohistoric hillfort, the Camp du Château, which was occupied during part of the Bronze Age (Piningre/Ganard 2004).

The wooded areas surrounding Salins-les-Bains constitute an accessible and relatively well-preserved environment, as they are less disturbed by agricultural activity than the plains and foothills. This area is particularly well suited for extensive research on metal hoards, such as the one carried out since the early 2000s by a team of volunteer prospectors, scientifically supervised by professional archaeologists, members of research laboratories, universities, preventive archaeology institutes, and supported and authorised by the regional archaeology service of Bourgogne-Franche-Comté (Gauthier et al. 2025). Such an approach allows for a detailed study of the burial conditions and spatial distribution of discoveries, as well as their relationships with the topography.

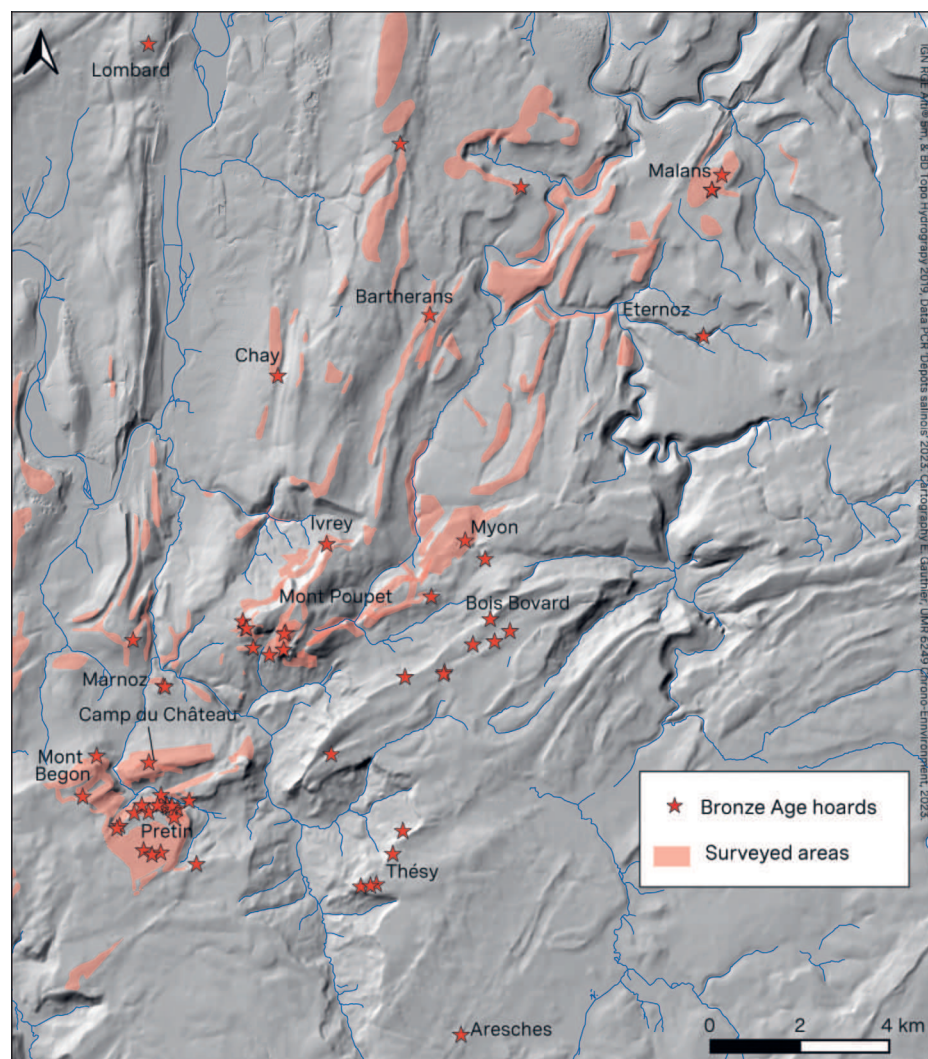
These surveys, conducted legally and formally within a 10 km radius around the fortified site of the Camp du Château, have so far covered over 5,800 ha (fig. 1). Currently, 85 hoards have been identified, mainly near the fortified site. This case study represents a rare example of a micro-region where the hoarding phenomenon can be studied from a representative number of hoards, particularly in terms of chronology. Indeed, almost all phases are represented

(fig. 2), as the earliest known hoards in the Salins area date from Bz A2–B1, while the most recent belong to Ha B2–3. However, a majority of datable assemblages correspond to the transition between the Middle and Late Bronze Age (Bz C2–D1), a particular phase evidenced by the typology of the objects found (Cressier or Boismurie-type axes, Penkhof II A or Grenchen-type sickles, Favargettes-type pins, etc.) (Piningre/Ganard 2017; Piningre 2024). Several large hoards also date from the late stage of the early Late Bronze Age (Bz D2–Ha A1). They clearly differ from earlier hoards by their typology, which includes eastern types characteristic of the Rhin-Saône and Jura regions (middle-winged axes, Gochsheim-type sickles, Binningen-type pins, Publy-type bracelets, key-shaped pendants) (Piningre 2024). The extended chronology of the hoards in the Salins area, even though not all phases are represented by an equivalent number of discoveries, allows for comparisons of hoarding practices across assemblages with very different compositions.

Fragment Hoards in the Region of Salins-les-Bains

Considering the chronology of hoards in the Salins region, it is evident that they follow the same trends as in the rest of eastern France (fig. 3). The hoards of Bz A and Bz B are mainly composed of axes and ingots, similar to the two Langquaid-type axes in Hoard 2 from Saint-Thiébaud – the Signal (départ. Jura/FR) (Bz A2) (fig. 3A) or the flanged axe, related to the Sigriswil type, associated with ingot fragments from Hoard 2 from Pretin – Bois du Chaumois d'Amont (départ. Jura/FR) (Bz B1). The compositions diversify slightly at the end of the Middle Bronze Age, with more fragmentation. Thus, the hoards of Bz C2–D1 consist mainly of ingot fragments and axes, but sickles, daggers, a few small tools like chisels and, more rarely, some ornaments (bracelets, pins) and spear-

Fig. 1 Distribution of metal hoards from recent archaeological research in the Salins-les-Bains region (départ. Jura/FR). – (Cartography E. Gauthier).



heads also appear. For example, Hoard 1 from Eternoz (départ. Doubs/FR) (**fig. 3B**) consists of about ten flanged axes or Norman-type plastaves, three fragments of Penkhof II A-type sickles, two fragments of spearheads, a fragment of torque, and another of a pin, associated with about a dozen ingot fragments. The hoards of Bz D2–Ha A1 contain a much higher number of pieces from a wide variety of categories, particularly weapons and jewellery, which are highly fragmented (**fig. 3C**). These hoards are similar to the previously mentioned examples from Publy or Cannes-Écluse (départ. Seine-et-Marne/FR). Finally, the hoards from the end of the Late Bronze Age (Ha B2–3), though fewer in number, tend to show

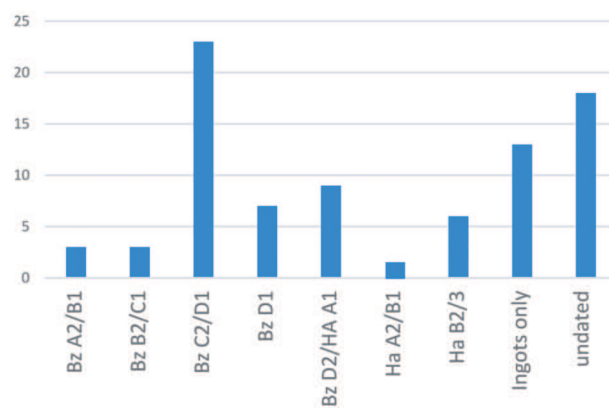


Fig. 2 Chronological distribution of hoards found since the early 2000s in the Salins-les-Bains region (départ. Jura/FR). – (Graphics E. Gauthier).



Fig. 3 Examples of hoards from the Salins-les-Bains region (dép. Jura/FR) showing characteristic compositions for each main phase: **A** Signal 2 (Bz A2). – **B** Eternoz 1 (Bz C2–D1). – **C** Pretin 12 (Bz D2–Ha A1). – **D** Signal 3 (Ha B2–3). – (Photos J.-F. Piningre/H. Grut).

a resurgence of intact objects. They form coherent assemblages that could be seen as personal equipment, like Hoard 3 from the Signal, which contains two knives, a spearhead, an adze, several socketed or winged axes, two ankle rings, and a series of decorated bracelets of the same type (**fig. 3D**).

The assemblages from the Salins region thus have compositions that are fully representative of the major trends seen across eastern France. Among all the types of hoards identified, the assemblages from Bz D2–Ha A1, notably those from Chay (dép. Doubs/FR), Pretin 12, and Myon (dép. Doubs/FR), correspond most closely to what we could call »scrap hoards« (**tab. 1**). Indeed, they are almost exclusively composed of fragments, which together represent a considerable total metal mass (from 1.7 to 6 kg of metal). These are, in terms of the number of fragments, the largest hoards of this area. In this respect, they differ from certain Bz C2–D1 hoards, among which, alongside large and heavy hoards, are some so small that they represent only a few hundred grams of metal in total (this is the case for 14 out of the 29 hoards that are surely dated to this phase).

		Myon	Chay	Pretin 12
Weapons	sword	5	9	
	dagger	5	1	2
	arrowhead	2	1	
	spearhead	22	5	2
Chariot		2		
Tools	axehead	27	10	6
	awl	1		
	chisel	5	1	1
	knife	11	10	5
	sickle	75	41	31
	other tool	5	2	5
Ornaments	rings and chains	41	1	10
	belt	16		
	buttons	14	4	1
	bracelet	42	22	9
	pin	12	3	3
	fibula		1	1
	leg ring	30	36	12
	pendant	30	14	7
	pearl	3	1	
	torque			2
Foundry		119	41	35
Miscellaneous		30	12	8
Undetermined		121	78	24
TOTAL		618	293	164

Tab. 1 Summary table of the composition of the assemblages from Myon, Chay (both dép. Doubs/FR), and Pretin 12 (dép. Jura/FR). – (Table E. Gauthier).

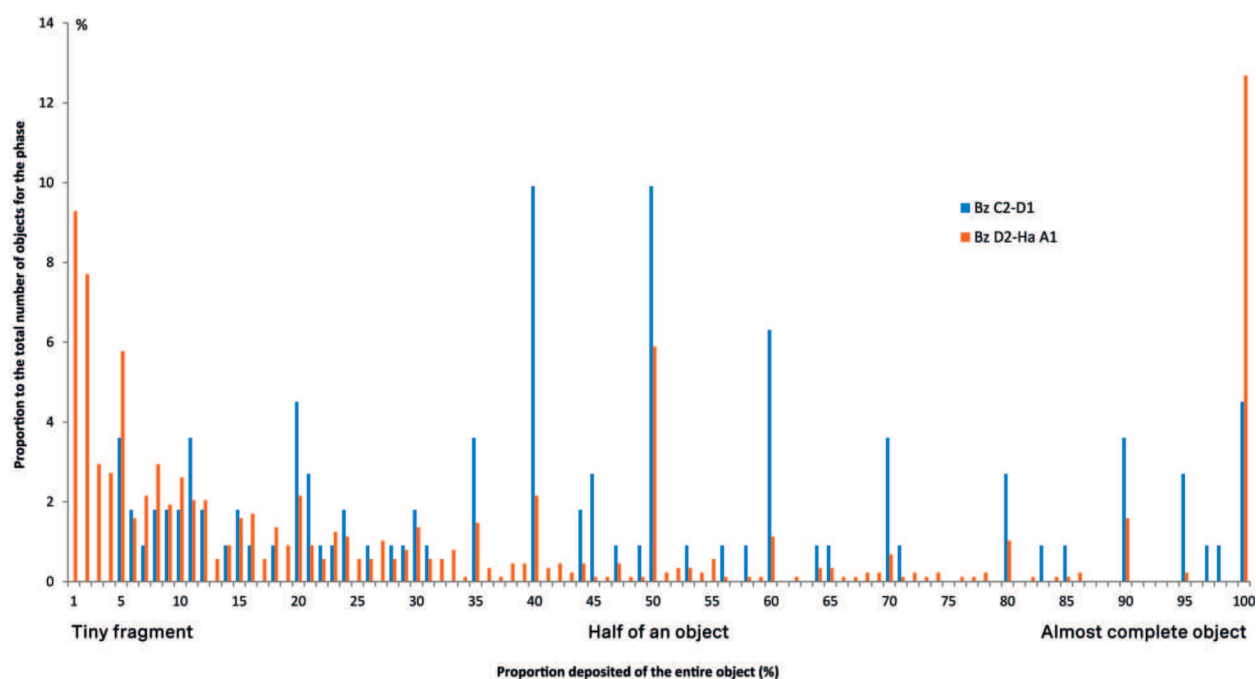


Fig. 4 Proportion of deposited objects compared to the complete models: comparison of hoards from Bz C2–D1 and Bz D2–Ha A1. – (Graphics E. Gauthier).

Furthermore, unlike Middle Bronze Age hoards, the raw material in the form of ingot fragments occupies a smaller place, while the selection from the entire diversity of existing functional categories may better correspond to a selection of unusable items taken from the circulating stock.

However, even though the differences are clearly marked between the hoards of Bz C2–D1 and Bz D2–Ha A1, the observed changes are not necessarily sudden. Indeed, jewellery and weapons seem more numerous, and their representation increases from the end of the Middle Bronze Age. This is also true for fragmentation, which is already present in Middle Bronze Age hoards, while complete items are rare. Nevertheless, it is not so much the rate of fragmentation that varies significantly between phases, but rather the degree of fragmentation. The fragments from Bz C2–D1 are statistically much larger than those from the hoards of Bz D2–Ha A1 (Gauthier et al. 2023). **Figure 4** showing the proportion of fragments compared to complete objects (expressed as a percentage) clearly highlights this difference, as the pieces in Bz C2–D1 hoards are more often close to halves of objects, whereas those in Bz D2–Ha A1 hoards typically represent less than 30 %, or even less than 10 %, of the original models. The fragmentation is such that the smallest pieces weigh less

than 0.2 g, and the rate of indeterminate items (too small to identify their original form) is around 20 %. With a few exceptions, most of the fragments weigh less than 100 g.

It should also be noted that fragments rarely refit, which is inconsistent with the idea of breaking objects solely to reduce their size. There seems to have been a selection among the available fragments after they were cut. An exception is a sword from the Chay hoard, which was cut into seven pieces of roughly similar length, about 5 cm. The tip is missing, but part of the hoard is likely still buried beneath a tree stump that could not yet be removed. The case of this sword is quite unique among the Salins hoards, suggesting that it received particular treatment. Other pieces have been inflicted with specific treatments as well, as they not only show clear signs of deliberate cutting but also of twisting, bending, and other significant deformations. This is especially true for the spirals of leg rings, which were systematically unwrapped, as well as the hoops of certain bracelets. Sheets of metal were folded, even shredded. Pins often have their shafts twisted. The disc-shaped head of a pin from Pretin 12 hoard was bent. A spearhead from the Chay hoard had its wings flattened against the socket, while another displayed a crushed socket, a bent tip, and alternately twisted wings. Some

objects were partially melted, while others showed signs of impact. The manipulations were thus numerous and varied, not limited to merely breaking the objects.

Therefore, more than any other hoards in the Salins region, these three assemblages from Bz D2–Ha A1 most closely fit the definition of »scrap hoards«. But while they clearly differ from the hoards of the preceding phase, the changes appear to be the result of a gradual evolution. This phenomenon likely reflects a change in the practices of selecting pieces, accompanied by other acts of destruction that cannot be explained solely by practical considerations.

While there does not seem to be a true break in the composition of the hoards, but rather an evolution, will other criteria, such as the modes of deposition and choices of location, lead to the recognition of a significant change in perspective regarding the nature or purpose of the practice of metal hoarding?

The Location and Context of Hoards in the Salins Region

The spatial distribution of hoards in the Salins region allows us to identify several concentrations near the fortified site of the Camp du Château. While around 20 discoveries are isolated to the north of Mont Poupet (départ. Jura/FR), the vast majority of hoards seem to be concentrated in the Salins-les-Bains valley, within about a 5 km radius around the fortified site (**fig. 1**). Several key areas stand out, such as the Pretin plateau (24 hoards), the western end of Mont Poupet (8 hoards), the crest of Bois Bovard (7 hoards), and the edge of the Thésy plateau (5 hoards).

Some hoards from Bz D2–Ha A1 are relatively isolated. This is the case for the hoards from Chay and Aresches (départ. Jura/FR), which are not in the immediate vicinity of the Camp du Château. The Chay hoard is isolated to the north of Mont Poupet, while the Aresches hoard is about 10 km to the southeast. However, other hoards from Bz D2–Ha A1 are close to discoveries from other phases. For example, the hoard from Myon, although slightly set back from the Salins valley, is not far from the hoards on the

southern slope of Mont Poupet. It is less than 600 m from another hoard from Bz C2–D1 found at a place called Chaudreux. The Pretin 12 and Bois du Chau-mois d'Amont 1 hoards are only a few hundred metres away from other hoards dating to the Early and Middle Bronze Ages. Belonging to the exceptional concentration of hoards on the Pretin plateau, they seem to be part of the same phenomenon. Thus, it cannot be said that the hoards from this phase had a significantly different distribution from those of other phases.

The Salins hoards were also found in specific topographical contexts, among the wide variety of configurations possible within this highly contrasting landscape. Most are in elevated positions, on the edge of plateaus, on ridges, or on hilltops, which characterises the hoards of the Abhangdepots type, according to Soroceanu's classification (Soroceanu 1995, 23 fig. 3). This type of location offers a strategic view of the valleys below and often of a passageway. The hoards on the western tip of Mont Poupet, which dominates the entire area at an altitude of 850 m and overlooks the town of Salins-les-Bains, are particularly well-exposed. As for them, the hoards on the edge of the Pretin plateau have a direct view of the Camp du Château, located just across the valley, less than 1 km away as the crow flies. They also overlook the Vache glen, a preferred route connecting the present-day village of Bracon (départ. Jura/FR) to the village of Pretin, located at the foot of the Château hill. Those on the western edge of the plateau also overlook a combe providing access to the plateau itself. The Bois Bovard hoards, as well as those on the southern slope of Mont Poupet, overlook the Todeur valley, which provides access to Salins from the east. The Chaudreux hoard, located atop a small rocky spur, also overlooked the Lanquétine pass, a passageway carved into the rock that likely constituted a major axis connecting the Salins area to Besançon (départ. Doubs/FR) since ancient times (Jeannin 1972). Lastly, the discoveries at Thésy border a plateau with steep slopes forming a large cirque in the southern part of the valley.

One of the main configurations is characterised by the choice of flat areas close to the slope break. Some items are sometimes found on the slope, likely

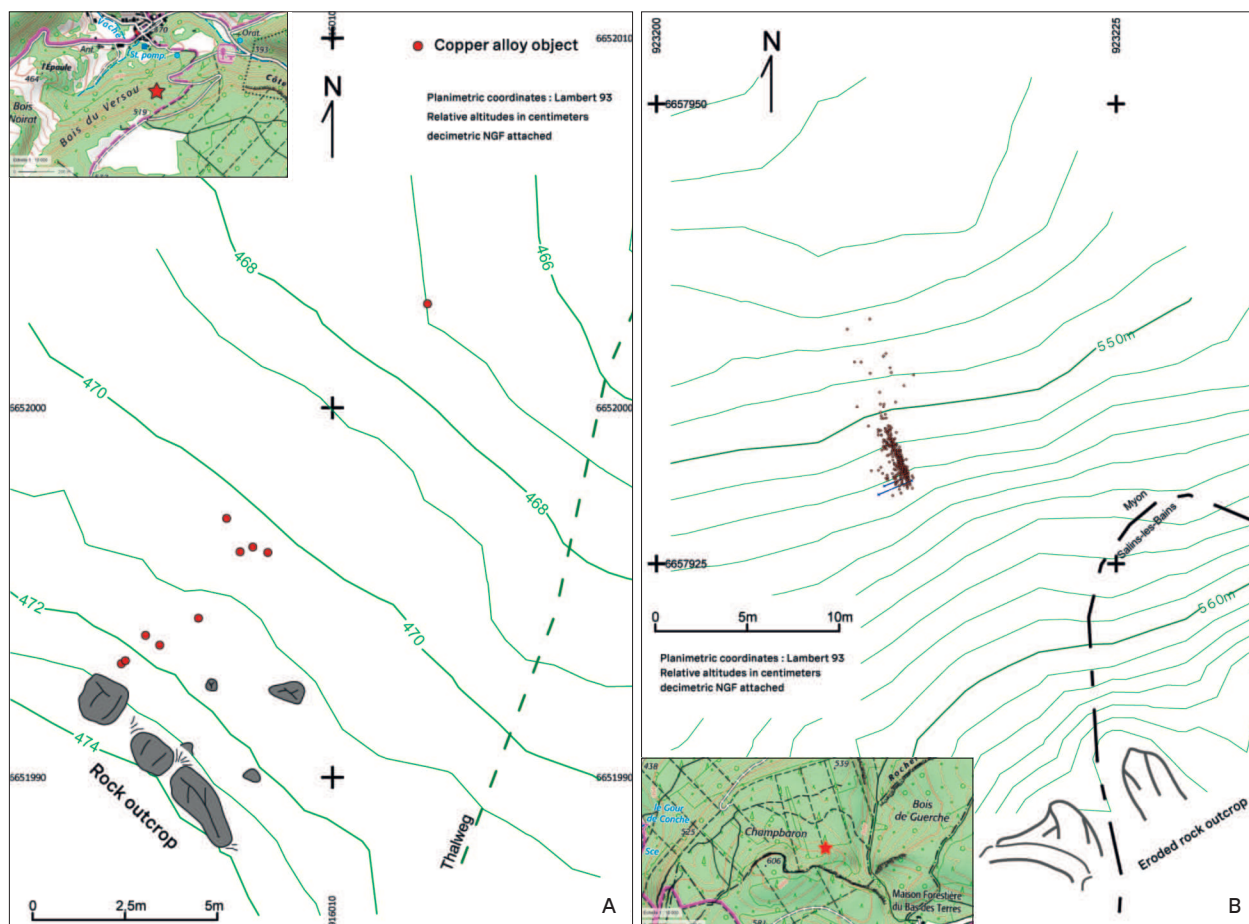


Fig. 5 Topographical survey of the hoards Pretin 20 (A) and Myon (B). – (Surveys J.-B. Caverne).

due to erosion. This is the case for Hoards 13 and 14 from Pretin (Bz C2–D1), where some objects were scattered across the flat area at the edge of the plateau, while other fragments appear to have slid down the nearby slope. However, many hoards were also located directly on the slopes. Some assemblages found below the edge of the plateau may originally have been placed near the escarpment but were displaced by erosion, sliding lower (fig. 5). In fact, the objects are generally found close to the surface. This shallow burial depth may be both the cause and the consequence of the high mobility of the objects, linked to the fragility of the formations in this environment. The Salins region thus presents an unconventional type of hoard, both widely dispersed and shallowly buried, positioned in very specific topographical contexts – a choice that appears entirely deliberate.

These types of discoveries are highly characteristic of the hoards from Bz C2–D1, the most represented phase. This is the case, for example, with Hoard 20 from Pretin (fig. 5A). However, similar observations can also be made for hoards from other phases, including those from Bz D2–Ha A1. For instance, the hoards from Myon and Chay were both located on a large slope. Both show a scattering of pieces down the slope. However, the Chay hoard was located on a small flat area, in the middle of the slope, featuring rocks and a tree stump, which may have limited the sliding of objects. The Myon hoard, on the other hand, was dispersed in a narrow band about 1 m wide and 10 m long (fig. 5B). The fragments were located at the base of a scree originating from a rocky outcrop forming a ledge several metres high. Its topographical position is similar to that of other older hoards, such as the hoard from Ivrey (départ. Jura/FR)

(Bz D1) or Pretin 11 (Bz C2). Hoard 12 from Pretin was located at the top of a steep slope, just below the edge of the plateau, also dominated by a rocky outcrop (Piningre/Grut 2009, fig. 4). The objects were scattered down the slope over a band about 6 m wide and nearly 40 m long.

Thus, for the »scrap hoards«, the topographical choices and burial conditions are the same as those for assemblages of other compositions. The conclusion of these observations is that there is no reason to

think that fragment hoards corresponded to a practice different from hoards from other phases. In other words, in the Salins area, there is no justification for interpreting fragment hoards differently from hoards of raw materials, whole axes, ornaments, or personal equipment. Despite the extent of the long chronology considered, all hoards seem to follow the same topographical choices, and their distribution suggests a very coherent whole, particularly in the area closest to the Camp du Château, all around the valley.

Symbolic and Social Aspects of Metal Hoarding Practices in the Salins Region: an Interpretative Attempt

Although some hoards may evoke stocks of raw materials (in the form of ingots) and/or fragments to be recycled, we will now present several arguments that lead us, on the one hand, to doubt the purely pragmatic nature of the burial of these sets of metal objects, and, on the other, to consider explanations that are more closely related to the social and symbolic character of this practice.

The fact that the search for hoards was carried out as systematically as possible and over a large area has made it possible both to cover a substantial and representative portion of the territory and to analyse the practice of metal hoarding over a long period, from the Early Bronze Age to the end of the Late Bronze Age. We can consider this case study as a homogeneous set of comparable findings, and as we have seen in the previous section, it seems to be part of a common phenomenon that can be understood as a whole. For the hoards known from Bz D2–Ha A1, although they are fewer in number, there does not appear to be a break in practice over the long term, except for particularities in piece selection and the intensity of fragmentation in certain phases, which are not incompatible with the idea that the hoards from the Salins area may have served a single purpose or, at the very least, corresponded to a common practice at the micro-regional scale.

Metal Stocks?

One could indeed consider that part of the hoards in the Salins area could have constituted significant stocks of metal. Indeed, the proportion of ingots and foundry waste is considerable. They are almost omnipresent, as 64 hoards contain at least one fragment of ingot or foundry waste. They represent more than 80 % of the composition of 31 hoards, 13 of which consist only of this category. For example, Hoard 11 from Pretin is made up of 89 foundry elements associated with a dagger, a fragment of a leg ring, and five fragments of sickles. Hoard 3 from Bois du Chaumoisi d'Amont consists of 34 fragments of ingots or waste, a fragment of an axe, and another of a sickle. One might wonder about the presence of such fragments of objects, which seem quite anecdotal among all this foundry waste. We realise that these are either axes or sickles, or personal items, small ornaments, or weapons. Were they included merely by chance, due to their mass being comparable to the other components of the hoard, or were they used to »personalise« the raw material deposit in some way?

The total mass represented by the hoard can also be an argument for interpreting it as a stock of raw materials. Whether through assemblages of ingots, heavy objects, like axes, or accumulations of small fragments, some hoards represent considerable

amounts of metal. This is the case, for example, with the Myon hoard, which, despite the average mass of the pieces being only 10 g, represents over 6 kg of metal. The heaviest hoard in the Salins region is the Saizenay hoard (département Jura/FR), which represents a total of nearly 9 kg of metal. It consists mainly of axes and ingots, averaging 387 g per object. Thus, 35 hoards represent more than 1 kg of material.

However, it is relatively low compared to the total number of assemblages discovered. Indeed, 40 hoards weigh less than 800 g, 23 of which do not exceed 200 g. It is very difficult to imagine that such small masses were truly worth gathering as metal stocks. In reality, economic interpretations are not convincing for the majority of the hoards in the Salins area.

Furthermore, it should be noted that few fragments fit together, which tends to show that the objects were not crushed merely to reduce the size of the fragments, but rather that a selection was made to retain only a few. Indeed, the rest of the objects are absent, and it is reasonable to consider that they may have been remelted. Thus, we would not be dealing with metalworkers' stocks, but rather with the result of a selection from objects, the remaining parts of which were likely put back into circulation, joining the true stocks of raw material (or maybe other hoards that also do not have a metallurgical purpose).

The Value of the Deposited Objects

Metalworkers' stocks would likely contain objects recovered from the daily life of local communities – items rendered unusable through prolonged use, whose original function is no longer of any real importance since they are to be transformed. This type of reserve would, therefore, consist of objects with a relatively low or medium social value. However, it is worth noting the significant proportion of gendered objects (both male and female) with high social value, particularly in the small fragment hoards from Bz D2–Ha A1. Weapons (especially spearheads and swords) and ornaments (leg rings, belt elements, bracelets, pins, fibulae) hold a remarkable place in these hoards. Even more notably, metal ware appears to be present among the numerous fragments

of sheet metal, and possibly elements of defensive weaponry. The Myon hoard contained, in addition to fragments that may belong to cauldrons, rarer pieces such as a fragment of a chariot wheel hub, a meat hook, and fragments of decorated thin sheet metal, which likely constitute the remains of a gold-plated »diadem« support, known in rich female burials of this phase (Binningen, Canton Basel-Landschaft/CH) (Unz 1982). The Chay hoard, in addition to the sword fragmented into seven pieces, also yielded two waterfowl figurines. Thus, the fragment hoards of Bz D2–Ha A1 are not necessarily just a jumble of scrap metal, but some of them could reflect heightened social or symbolic value.

At the scale of eastern France, similar observations have been made. The diversity of object categories represented is accompanied by a development in the social value of certain pieces. The proportion of weapons and jewellery increases, while objects of higher social value appear, such as wagon elements or metal ware. The Publy hoard, for example, contains, among fragments of axes, sickles, ornaments, and other fairly common objects, a decorative element from a chariot. Some of these highly fragmented assemblages contain even more exceptional objects, such as the hoards of Bouclans (département Doubs/FR) and Cannes-Écluse, each of which includes a decorated half-greave. These pieces are rare across Europe, and some are adorned with motifs of wheels or waterfowl, perhaps linking them to the religious sphere (Hansen 1994, 13–19). These prestigious objects among various fragments are not insignificant and highlight the social and highly symbolic role of fragment hoards.

The jewellery hoards, such as the two pins of Hoard 1 from Bois Bovard, the collection of jewellery from Hoard 2, or the series of 19 bracelets from Ivrey, also do not seem to correspond to metal stocks. This is also the case for Hoard 1 from the Signal, which consists of two fragments from the same sword. Similarly, the assemblage of Hoard 3 from the Signal, described earlier, appears to have undergone a meticulous selection of pieces, which is incompatible with the idea of constituting a raw material stock. These assemblages of jewellery and weapons seem more likely to result from symbolic and social practices.

In the Salins region, goldsmithing is represented by a possible goldsmith's anvil in Hoard 1 from Bois du Chaumois d'Amont, as well as by two hoards consisting exclusively of gold items. Hoard 6 from Pretin contained 28 gold scraps (ring, disc, wires, ribbons) (Piningre/Grut 2009, fig. 12), while two gold ribbon ingots made up Hoard 3 from Marnoz (dép. Jura/FR).

Staged Depositions

Unfortunately, in the Salins region, many hoards have suffered from the effects of erosion, causing them to slide down slopes. Despite these taphonomic problems, which prevent us from knowing the exact arrangement of the objects in the ground for most discoveries, some observations were made on certain hoards, at least partially still in place.

This is the case for Hoard 1 from Bois Bovard, which is composed of two almost identical large pins, of the Arinthod-Vogna type (**fig. 6A**). These two

pins, measuring approximately 40 cm long, have a slight ribbed swelling and a solid flared head topped with three convex discoidal knobs. Each pin was bent almost halfway along its length into a rounded shape, forming two parallel branches, with the point extending a few centimetres beyond the head. Hoard 2 from Bois Bovard also yielded a large broken pin with movable collars, whose shaft had been bent three times upon itself (**fig. 6B**). The complex bending of pin shafts is frequently found in hoards from Transdanubia and Croatia (Hansen 1994, 295 fig. 192). However, in the case of Hoard 1 from Bois Bovard, the staging was not only in the identical bending of the two pins but also in how they were buried: they were placed vertically, in parallel, with the bend facing upwards, the heads and points downwards, between two large blocks on a karst ridge (Piningre/Grut 2009, figs 5, 10; Gauthier/Piningre 2025, fig. 6, 15).

Moreover, there is a strong connection with the natural environment of the sites, as several hoards were deposited in rock crevices. This is the case, for

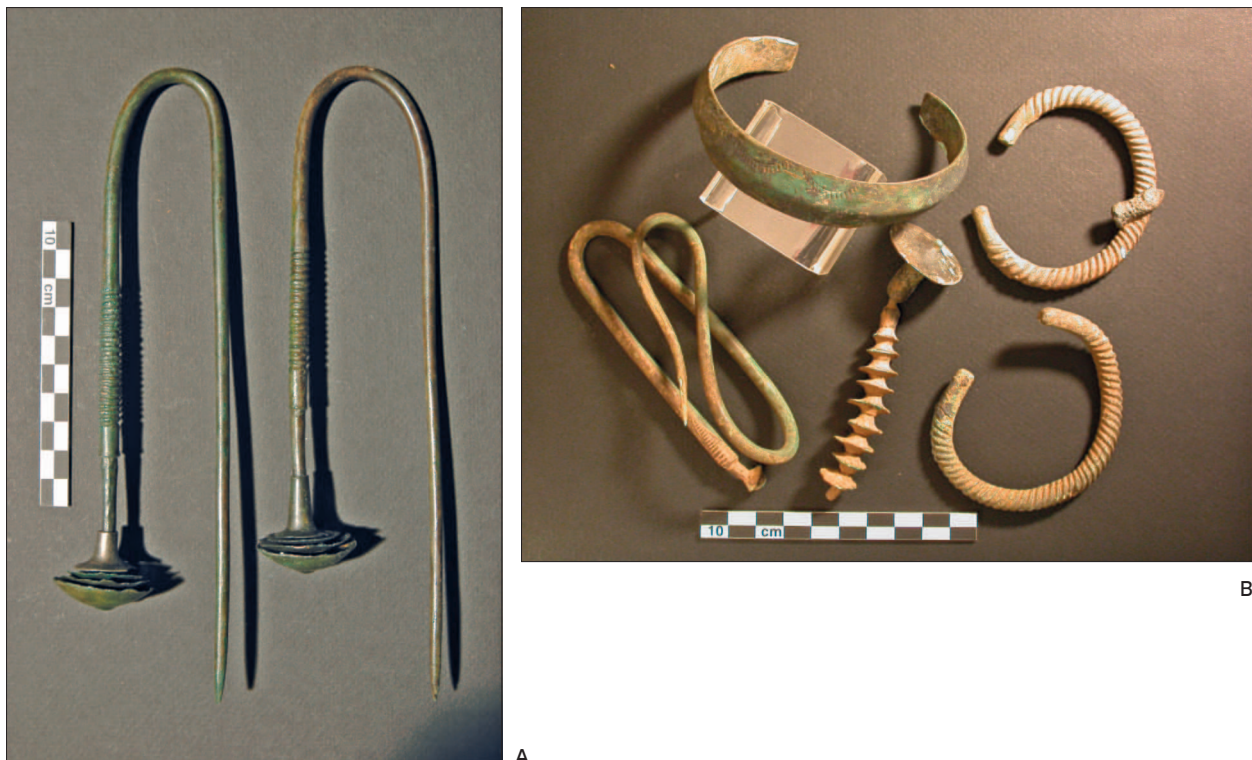


Fig. 6 Examples of excessively bent pins in the Salins hoards (dép. Jura/FR): **A** Hoard 1 from Bois Bovard. – **B** Hoard 2 from Bois Bovard. – (Photos J.-F. Piningre).



B

A

Fig. 7 Examples of hoards placed in rock fissures: **A** Saizenay hoard. – **B** Lombard hoard. – (Photos J.-F. Piningre).

example, with the Saizenay hoard, which was placed at the foot of a rocky escarpment at the top of a slope, within a vertical joint of a rocky spur filled with yellow clay. Some objects were still at the bottom of a horizontal fissure (**fig. 7A**). Hoard 2 from Bois du Chaumois d'Amont and the Lombard hoard (départ. Doubs/FR) were also found between large adjoining blocks forming a vertical fissure (**fig. 7B**) (Gauthier/Piningre 2025). These choices seem to reflect a need to protect the hoards by opportunistically exploiting geological anomalies, but they also indicate an intention to link the hoards to particularities of the natural context.

Similarly, some hoards were placed at the foot of large erratic boulders or rocky spurs at the edge of escarpments. Despite the taphonomic issues mentioned earlier, this phenomenon was observed for many hoards. Thus, most slope discoveries are located below such a dominant rocky spur, just at the edge of the plateau (**fig. 5**). Understanding the actual link between the hoards and these clearly visible natural features in the landscape is not straightforward, but they appear to have constituted a criterion for selecting the hoarding sites.

Locations that Argue for a Social Role of Hoarding

Each of the hoard concentrations corresponds to prominent areas of the landscape, highlighting the contact between the valley and the plateau. The near-systematic choice of elevated positions and the close connection with natural topographical landmarks (large boulders, karst ridges, rocky spurs) lead us to question the visibility of the hoarding sites. Although the hoards were buried, they likely held a specific place within the cultural landscape and the collective imagination of Bronze Age populations (see particularly Fontijn 2002; Hansen et al. 2012). They were not visible but were positioned in very exposed places. A visual link would have integrated them into the daily landscape, with their »presence« maintaining memory and traditions (Gauthier/Piningre 2016).

A comparison of the hoards' distribution with the area visible from the Camp du Château clearly shows a connection between the locations chosen for the hoards and the fortified settlement (**fig. 8**)

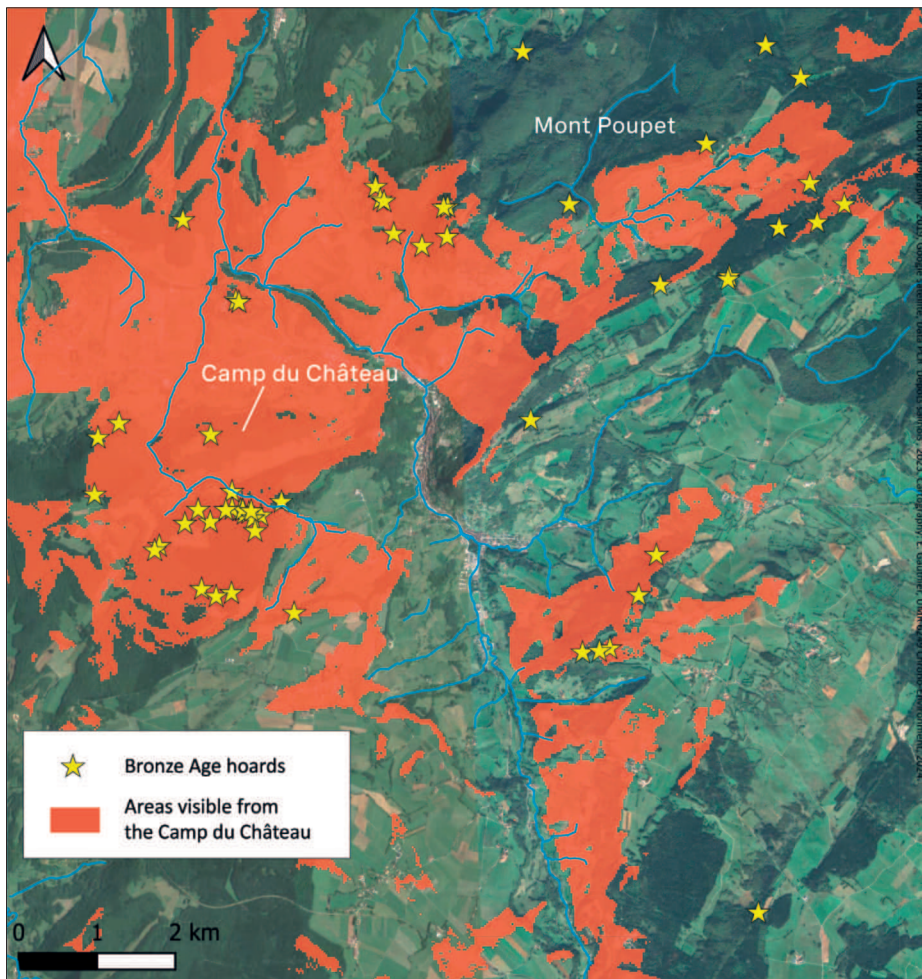


Fig. 8 Positioning of the hoards in relation to the areas visible from the Camp du Château. – (Cartography E. Gauthier).

(Gauthier/Piningre 2023). Within a 10 km radius, extending to the southern flank of Mont Poupet on one side and the Thésy ridge on the other, almost all the hoards are located in areas visible from the fortified settlement. The exceptional concentration of hoards on the Pretin plateau is located directly opposite the Camp du Château, while the other concentrations correspond to strategic areas in terms of visual control of passage routes (Mont Poupet dominates the entire valley, and the edges of the plateaus frame it). Away from settlements and cemeteries, hoards could be considered significant markers in the landscape, at the edges of the main access routes to the central-western Jura, between the Saône plain and the Swiss Plateau. Several examples elsewhere in Europe demonstrate a similar link between hoards and hillforts or major trade routes. This is particularly

the case in France, on the site of Jenzat (département Allier/FR) (Milcent et al. 2023), in Austria, in the Kainisch valley (Bez. Liezen/AT), not far from Hallstatt (Bez. Gmunden/AT) (Kowarik 2016; Windholz-Konrad 2002; 2005; 2010), in Germany, on the fortified site of Bullenheimer Berg (Lkr. Kitzingen/DE) (Diemer 1995; Nomayo/Falkenstein 2012; Diehm/Falkenstein 2012), and in Hungary, around the hillfort sites recently surveyed by G. Szabó's team (2016; 2017).

Finally, it should be noted that most of the hoards from Salins are not located in the centre, but at the edge of the areas visible from the Camp du Château. With the exception of the hoards on the edge of the Pretin plateau, they are almost systematically placed near the outer boundary of the visible surfaces from the hillfort. This phenomenon can be explained by the fact that the hoards are primarily situated on

ridgelines and the edges of plateaus, which form natural barriers, not only to movement but also to visual control. The hoarding sites appear to have been defined in such a way as to mark the border of the area that is controllable from the Camp du Château. If we follow this interpretation to its conclusion, we can hypothesise that the hoards marked the limits of the territory of the communities connected to the Camp du Château (Gauthier/Piningre 2016; 2017).

The rocky spurs or large erratic boulders, at the foot of which the hoards were placed, would serve

as true visual markers of the territory's limits. The connection between the hoards and these natural markers might correspond to ritualised and collective activities aimed at reinforcing the appropriation of this space by the local communities and elites concerned with consolidating their borders. Thus, by choosing strategic natural locations, the communities established sacred reference points, transforming these natural features into visible witnesses and the hoards into symbolic witnesses.

Conclusion

Given the great diversity of forms these hoards take, it seems natural to suppose that they fulfilled various functions, some serving a symbolic purpose and others serving an economic one. However, the example of Salins-les-Bains shows that fragment hoards do not necessarily have to be interpreted differently from other types of hoards. A comparative analysis of the assemblages from different phases of the Bronze Age first demonstrates that there is no clear break in the practice of metal hoarding, despite the diversity of compositions observed. The burial methods also do not appear to differ. The choice of locations, in elevated positions, mostly atop steep slopes and below rocky outcrops, is common to the hoards from Salins from various phases. Therefore, there seems to be no reason to consider that highly fragmented hoards had a different role.

Despite the interest that some of these assemblages could represent as metal stocks, this explanation does not convincingly apply to most of the discoveries, where the value of the objects appears to be significant and where the selection of pieces and the burial contexts point more towards social, and perhaps cultural, practices. The hoards identified through systematic research appear to form a coherent whole, resulting from practices conducted over an extended period within the valley, which may be linked to territorial marking.

In this context, we can propose that the fragmentation of bronze objects was merely one variable among others in metal hoarding practices, with variations that are solely related to the evolution of cultural codes. Fragmentation increased or decreased, sometimes becoming more intense, but its role remained the same. In the Salins-les-Bains region, if hoard interpretation leans towards social and cultural considerations, perhaps we should see fragmentation as a practice of destruction meant to strip objects of their profane value, consecrating them instead. The other manipulations observed on the items could be an argument supporting this hypothesis. Another plausible explanation for the fragmentation would be a symbolism related to the communities' belief in the concept of *pars pro toto*, where a part is sufficient to represent the whole object. The social act of sacrifice or offering would then be equally important as that of offering whole objects, but its impact on the economy would be considerably reduced, as the remainder of the object can re-enter the circulating stock. The *pars pro toto* is as symbolic as it is pragmatic. The *pars pro toto* is as symbolic as it is pragmatic. The advantage of this practice is even greater, especially in the Bz D2–Ha A1 phase, a time when fragmentation is extreme and metal hoarding appears to become more collective, requiring the investment of a much larger number of metal objects.

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Across Europe and the Mediterranean, vast numbers of deliberately fragmented artefacts have been unearthed from hoards and ritual contexts. This volume explores the cultural, ritual, and practical motivations behind the phenomenon of fragmentation, spanning from the Copper Age in Western, Central and South-eastern Europe to the Archaic period in Greece.

Bringing together contributions from leading international scholars in archaeology, archaeometallurgy, and conservation, the volume originates from an international conference held at the Leibniz-Zentrum für Archäologie in Mainz in November 2023. The case studies range from new evidence from the important Greek sanctuary of Olympia to material from the Copper and Bronze Age in Europe, offering new insights into the meaning, function, and afterlife of broken metal objects.

From ritual destruction to recycling economies, this book presents various current research approaches and challenges the traditional binary of the sacred and the profane, proposing instead a new understanding of fragmentation as a complex cultural practice. It is an essential resource for scholars interested in ritual behaviour, object biographies, and the intricate material entanglements of past societies.

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